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STEPHEN H. GODDARD
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GENERAL REPRESENTATIVE

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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

Evidence of a belief in the future importance of electricity in the home comes from the fact that the authorities of a certain eastern technical college have prescribed studies in certain branches of applied electricity for the course in domestic science. This certainly shows a foresight which is to be highly commended.

It is pleasing to note another success which has been scored by the electric fan. The air in the royal sick chamber at Buckingham Palace has been kept cool and in circulation by this means, much to the benefit of his Majesty's health and comfort. This little machine is now a recognized necessity in all well-appointed sick rooms and hospitals.

ELECTRICITY AT THE INTERNATIONAL EXPOSITION AT ST. LOUIS IN 1904.

While recently looking into the plan and scope of the World's Fair to be held in St. Louis, we were surprised to find that there is good foundation for the belief that it will be a $50,000,000 enterprise. A World's Fair of this magnitude should not pass without carrying with it the history of a memorable display of electrical exhibits, as well as of a grand electrical illumination.

That the illumination will meet expectations we may assume to be assured, as provision is being made for 30,000 available horse-power, an amount greatly in excess of what has been available at any other exposition. This power is provided by the exposition.

The success of the electrical exhibits, however, rests with the electrical industry, rather than with the exposition authorities, and there should be that united cooperation among the electrical manufacturing interests which will ensure every department of electrical endeavor being adequately exploited.

The Electricity Building seems to have received the most favorable location of any building on the grounds, and is architecturally one of the handsomest. In addition, space is free. What more favorable conditions could be asked?

Under the classification, complete electric light installations, the electric transmission of power, the application of electricity to transportation, electrochemistry and telephony, etc., are all accredited to the Department of Electricity. The classification is broad and comprehensive. Picture the result of a grand general electrical exhibit developed in a broad way! Think of its effect, not only upon this country, but upon the world!

St. Louis calls for united action and prompt decision to do something worthy. Electricity should lead.

SWEARING AT THE TELEPHONE.

A physician was arrested in St. Louis, Mo., a week or so ago for swearing through a telephone at an employé in the central office. The doctor confessed that this was the case, but in his defence said that he was swearing at the system and not at the employés. Judge Sidener, of the First Municipal District Court, found that the defence was insufficient and fined the profane gentleman $5 for using abusive language.

Now, why do people swear, either at the telephone, at the operator, or at the system; particularly why do physicians swear? We venture to suggest that had the gentleman in question ever visited a central exchange, and could he see the rapidity with which the operators carry on the service, and understand only in the smallest manner the wonderful organization which brings order out of a seeming chaos, he would be disposed to be patient if perhaps his call was not answered immediately, or sooner than that. It seems, however, that one man finds occasion to swear at the telephone for not serving him quickly enough, and the next man swears as it for calling him too often. The telephone has cut the time for transaction of business down to next to nothing, and naturally its service is wanted in the greatest haste. The man who pays for the service understands that, the operator understands that, but most of all the system understands it better than any one else, and the learned judge will no doubt have the endorsement of all who really understand how fast and how efficient the modern telephone service has grown to be.

APPLIED ELECTROMETALLURGY.

The astonishing growth of applied electrochemistry and electrometallurgy has been a subject of note, particularly in connection with the Niagara developments. Here large blocks of power are to be had at low prices, a necessary condition for the

successful operation of many of the methods, and we may look forward with confidence to still greater developments here along this line.

Many engineers and others are devoting themselves to various branches of the subject, and the published descriptions of electrometallurgical and electrochemical processes, as well as the number of patents taken. out, are indicative of general activity in this direction.

There is, however, one branch of this work in particular which deserves attention, and in which rapid development is to be expected. This is in the direction of electrical processes for treating ores. Although the progress which has been made in certain lines of this work—notably that of gold extraction from low-grade ores—has been very great, there are others in which the results have not been so satisfactory. A number of failures which have operated to seriously retard the healthy growth of this industry have been due to over-confidence on the part of the inventors of the processes. They expected to step at once from a laboratory method to a gigantic application without the necessary study of the commercial conditions of the problem. It was thought that because a process could be carried out successfully in the laboratory it would be successful in practice, and large and expensive plants were erected. Unfortunately, the conditions met with in practice on a large scale presented unforeseen difficulties. This fact has now been realized, and new methods are generally tried on a small scale before large investments are asked or large works erected. This is as it should be, for the risk of failure should not be incurred for the sake of having the process begin paying a little sooner.

Another matter closely related to this is the attention which the later theory of electrolysis has been attracting. Whether we accept this or not, it can not be denied that many valuable new processes and improvements in older methods have resulted from this study. This fact alone offers sufficient reason for advocating thorough instruction at the technical colleges in the subject. The electrochemist of the future must be a man who has thorough training in the theory, as well as a good knowledge of what has been accomplished in practice.

THE ELECTRON.

Dr. J. A. Fleming has given an interesting analogy of the manner in which a magnetic field is set up by an electron. The electron is likened to a sphere submerged in a fluid, and containing the same fluid under pressure. This issues from all sides in radial jets. As long as the sphere is stationary, these jets correspond simply to lines of force due to the charge of the electron, the surrounding fluid representing the ether. If the sphere be moved certain of these jets will be moved through the fluid in a direction at right angles to the stream. This shifting of the jets will set up whirls in the surrounding fluid, the axis of rotation being normal to the direction of motion of the sphere and to the jet. These whirls represent the lines of magnetic force set up by the motion of the electron. If we imagine jets issuing from every point of the sphere, we see that the motion of the sphere will set up a whirl which will completely surround the sphere. A continuous stream of these spheres moving through the fluid is analogous to an electric current, the whirls set up in the fluid representing the lines of the magnetic force surrounding the current.

One objection always urged against the use of induction motors of the squirrel-cage rotor type is their poor starting qualities. This is overcome in an interesting manner in the installation for pumping in the Horcajo mines, Spain. Each motor is connected to a high-pressure centrifugal pump, and three pumps, placed at different levels in the mine, are connected in series to overcome the hydraulic head of 1,272 feet. In starting, one generator is run somewhat below normal speed. Then the first motor is thrown on an autotransformer and, after having come up to synchronism, is transferred to the generator and the second started on the autotransformer and so on. The motors start in this way at zero torque and since, at the lower speed, they can not overcome the hydraulic head they absorb but little power. After all three are running the generator is speeded up and delivery of water begins. It should be noted that since the pumps are in series all the motors run at the same speed and handle the same amount of water, they all do the same work irrespective of their vertical distances apart.

MOTOR TESTING.

In a recent issue of the *Electrotechnische Zeitschrift* the Prony brake method of testing motors is discussed, attention being called to the difficulties encountered in applying this test and to the usual sources of error which are to be avoided, as far as possible. The writer lays particular stress upon the necessity of obtaining accurate readings of speed, as in this test any error made here will result in an equal percentage error in the efficiency as determined in this way.

The method advocated for overcoming errors due to inaccurate readings of the instruments, either as regards the instant of taking the reading or in the value of the reading itself, is to so mount all the instruments that a photograph may be taken and an instantaneous record obtained which is independent of personal errors.

It is very doubtful if results obtained in this way would be more accurate than these obtained in the old method, by personal observation. The very thing the author is trying to avoid—that is, variations in the instrumental readings while they are being noted—will cause an error here because changes in the speed of the motor will always lag behind changes in applied voltage or in the load, and it is a question as to which method will give the better results.

But be that as it may, there is seldom any necessity for testing a motor for efficiency by applying an actual load. The method of computing the efficiency from the measurements of the friction and core loss and armature and field resistances gives more satisfactory results. Here the resistances may be measured as accurately as desired, while a considerable error in the core loss determination will cause but a slight error in the computed efficiency. The objection to this method is that the motor is not tested under actual running conditions, but if it is clearly stated that the efficiency has been determined in this way the objection can not be considered serious. And on the other hand, the advantages of this method are considerable. The time required for making the test is short and the power required is small.

Professor F. Braun's System of Wireless Telegraphy.

Using a Closed-Circuit Oscillator.

By A. Frederick Collins.

MUCH interest is evinced in Germany in the system of wireless telegraphy invented by Professor F. Braun, of Strassburg, since Messrs. Siemens & Halske, who control his patents, have brought suit for infringement against the General Electric Company, of Berlin, owners of the Slaby-Arco system.

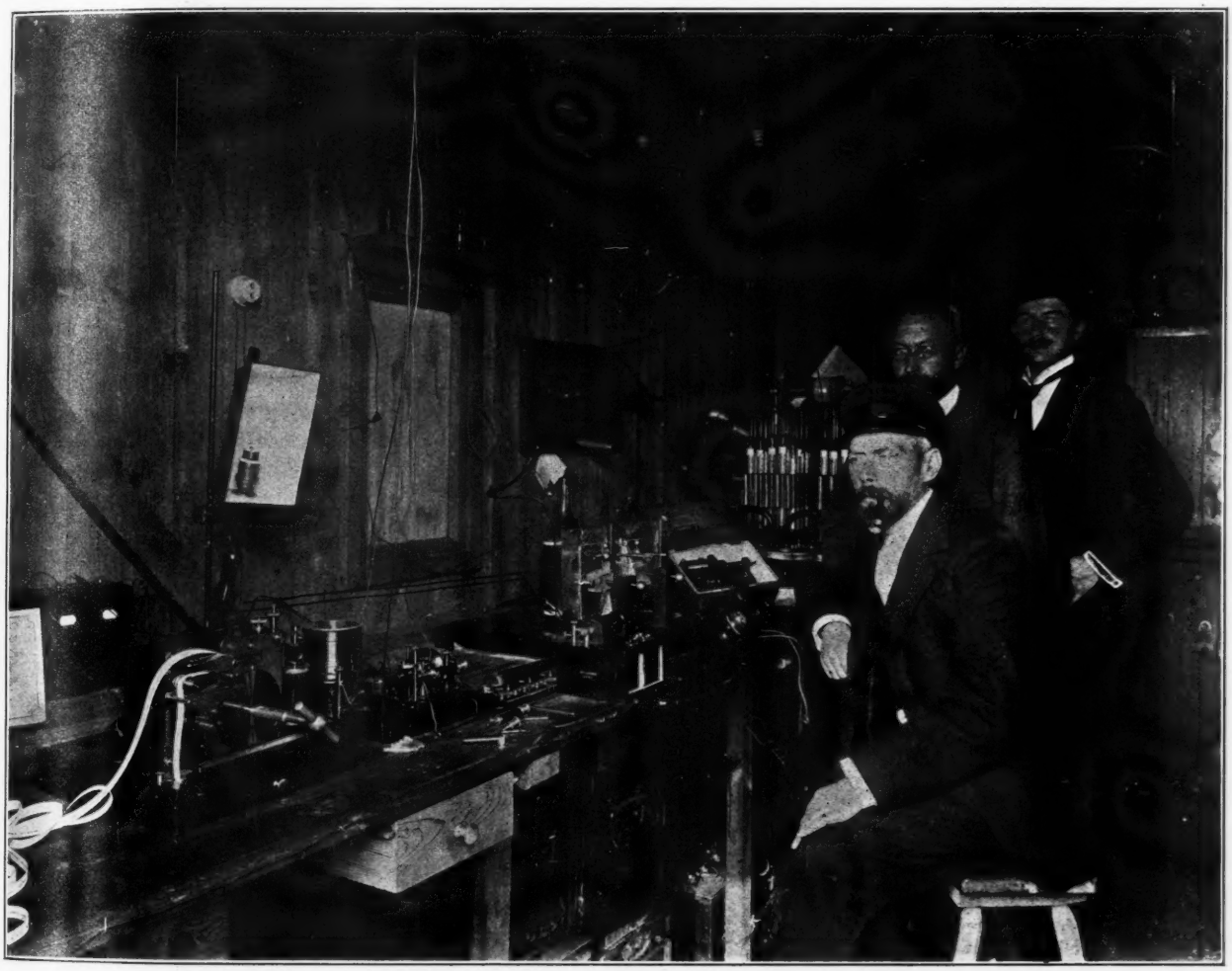


Fig. 1.—Complete Apparatus for Braun's System of Wireless Telegraphy. Professor Braun in Centre, Dr. Koetsel, Siemens & Halske's Expert, in Foreground.

The system of Professor Braun and Siemens & Halske is based upon the well-known fact that a closed circuit is a much more persistent oscillator than an open circuit. The Braun transmitting apparatus consists of a closed circuit oscillator, adjusted by means of appropriately selected values of inductance and capacity, and indirectly connected with an open circuit oscillator.

In this manner it is possible to limit the action of the transmitter so that electric waves of a certain definite length only will be admitted, while the receiver in connection with an open circuit resonator will permit the intake of these waves alone.

To increase the intensity of the waves to a maximum limit, an exact symmetry of design has been planned by Professor Braun, so that the electric waves propagated by the oscillations of the transmitter may find a suitable medium for producing resonance effects in this receiver.

To procure this symmetry in the transmitter and receiver in theory, as well as to ensure it in practice, Professor Braun has ingeniously arranged the component parts of the system so that there is no ground connection by direct contact, a feature now in vogue that characterizes every other apparatus for wireless telegraphy. It is this earthing of one terminal of the oscillator that is responsible for the many disturbing atmospheric effects. The absence of this grounding element in this system renders it absolutely free from the untoward influence of atmospheric electricity, and tests of a vigorous nature have justified this assertion.

The following description explains the system from a general viewpoint: Fig. 1 represents the apparatus complete. The diagram, Fig. 2, illustrates the theoretical principles of the transmitter, where S is the closed oscillator circuit which is excited by the secondary of the

induction coil, J, and upon disruptively discharging the oscillator between the spark-halls, S, oscillations are set up in the closed circuit, including S, the spark-gap, C, C, Leyden jar condensers and the inductance coil, L.

The high-frequency, high-potential oscillations of this circuit are now stepped-up by the transformer, consisting of the primary inductance coil, L, and the secondary coil, M, the terminals of which are attached to the open circuit oscillator, of which one arm joins the antenna, or vertical air wire, the other arm being joined by a conductor of similar length and thickness to the antenna, and which may be coiled up to reduce its length,

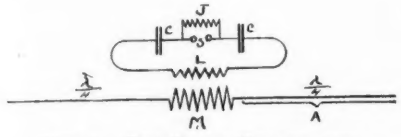


FIG. 2.—THE BRAUN TRANSMITTER.

though a simpler method is to attach it to an insulated plate of considerable area.

The receiver shown in Fig. 3 is constructed in a similar manner. The antenna, A, brings the impinging waves to the oscillating closed circuit represented by the condensers, CC, the wire, S, and the inductance, L, which is timed to the wave-length of the transmitter. The addition of a second conductor equal to $\frac{\lambda}{4}$ times the wave-length gives the proper symmetry to provide for resonance, and the waves react on M, like the condensation and rarefaction of waves in

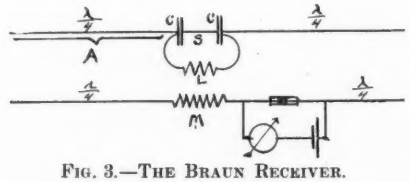


FIG. 3.—THE BRAUN RECEIVER.

acoustic primary resonance, causing the amplitude of vibration to be increased. The oscillations of L are transmitted to the secondary coil, M (Fig. 3), and by means of an additional conductor, having $\frac{\lambda}{4}$ the value of the wave-length, a resonance effect is obtained in M of great intensity. The conductors $\frac{\lambda}{4}$ may here, too, be replaced to advantage and in an easier and simpler manner by using plates of large area.

The transmitter of the Braun-Siemens-Halske apparatus is divided into two parts: (*a*) the inductor with its auxiliary appliances and the closed circuit oscillator necessary to excite the sending wire or antenna. The induction coil or inductor, as it is termed, is different from those used in other systems in that it is not wound to obtain high potentials, but by carefully calculating the dimensions of the iron core, the winding of the secondary coil exercises but a slight reaction on the magnetic circulation and, therefore, but little opposition to the primary current; the result is that the potential difference is somewhat less than in the ordinary types, but the oscillator circuit becomes, by virtue of this reduction, especially suitable for the loading of large capacities since it is designed for a small time constant of the charging circuit.

The induction coil has quite a long primary coil and inductor and a proportionately short secondary winding having small resistance. The decrease of potential mentioned is accompanied by a greater secondary current than is usual in coils of the older types; the winding, too, is arranged so that the loss by ohmic resistance is limited; the cross-section of the secondary winding is fairly large, consequently the heating by secondary currents is reduced to a minimum. Again, the coil designed by Professor Braun has double the insulation found in those of the ordinary type sold in the open market, and the result is that the function of the coil takes place at all times without trouble or breakdowns.

The rythmical interruption of the inductor is generally accomplished by means of a Wehnelt or Simon electrolytic circuit-breaker, which, by reason of its simple construction and ease of manipulation, has become popular, especially on the Continent, for operating coils for whatever purpose.

These interrupters have been described from time to time in the scientific journals as improved forms were brought out and so need no further elucidation here. Suffice it to say that this form, with certain modifications to prevent the explosions which generally took place in the older forms, is the one favored by Professor Braun. Where storage batteries are used or a small current available, Messrs. Siemens & Halske include a mercury radial (turbine) interrupter instead of the electrolytic form. The mechanical interrupter does not possess sufficient staying qualities for the requirements of a commercial apparatus in constant operation and is consequently to be avoided.

The Morse key or manipulator for making and breaking heavy currents into dots and dashes is little like the ordinary key used in telegraph practice. The Braun key is shown in Fig. 4 and enables the operator to break a current of fifty amperes continuously without danger to the automatic interrupter. For this pur-

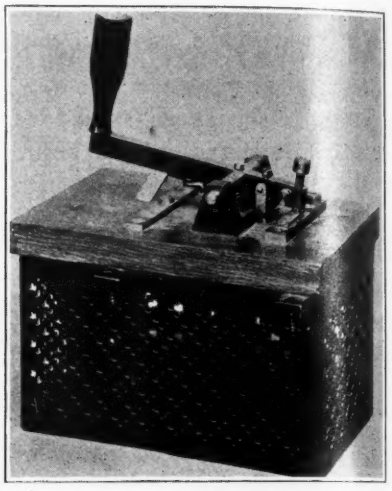


FIG. 4.—THE BRAUN KEY.

pose Professor Braun invented a method of closing the circuit separate from the point of break, so that the circuit is closed first and then the main contact; this contact, however, is opened first at the moment of break and but one path is left for the current, namely, through the discharger. Now, before the second phase of motion of the

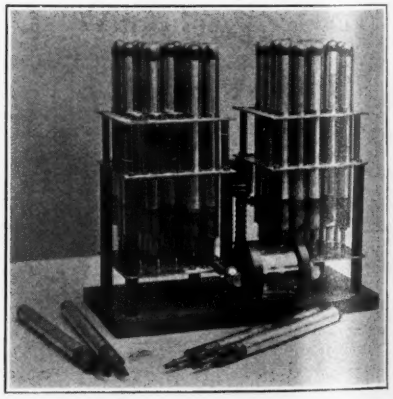


FIG. 5.—THE LEYDEN JARS.

key the discharger opens and the current is absolutely cut off. Thus the main contact always remains sparkless and in consequence of this device the break takes place with the least difficulty and with the ordinarily required rapidity.

The oscillation current consists of a series of Leyden jars shown in Fig. 1, in the form of a case of vertical tubes. They are represented in Fig. 2 by CC, and in Fig. 5 the details of the arrangement are shown. The oscillation circuit

also includes a transformer. To bring within as small a space as possible as large a capacity as necessary, the tubular form of Leyden jars was chosen. These tubes may be quickly exchanged or replaced if broken.

The transformer is under complete control and is carefully calculated. The wave-length selected should be such that the height of the vertical wire should be one-fourth its value. The secondary is adjusted to the wave-length to be used, but it is by no means dependent on the laws governing ordinary transformers. It must be regulated, however, so that it will be in tune with the vertical wire. These transformers are placed in oil, as powerful tensions are set up in them.

In the receiver of Professor Braun, although syntonized with the transmitter, the oscillations are, of course, comparatively feeble, and the condensers of the oscillating circuit of the receivers may be of much smaller dimensions than that employed in the transmitter.

Professor Braun doubts the value of exhausting the coherer, and if the filings are out of adjustment the tube or coherer must be discarded. The coherer he devised is arranged so that it could be taken apart and adjusted again with ease, even by the layman. The conductor plugs are of steel, and all that is required is that the ends should have a

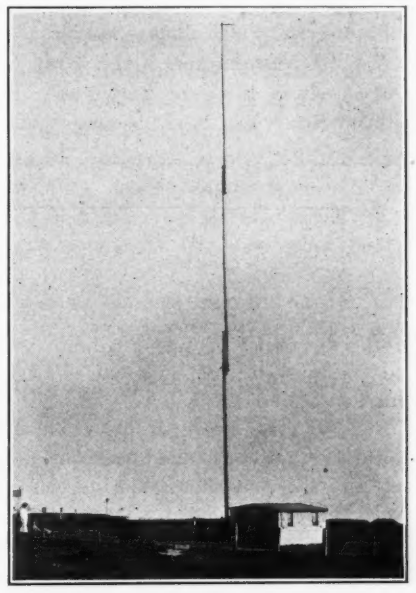


FIG. 6.—THE BRAUN STATION AT HELIGOLAND.

FIG. 7.—GUESTS WHO WITNESSED THE FIRST EXCHANGE OF MESSAGES BETWEEN HELIGOLAND AND CUXHAPEN. PROFESSOR BRAUN IN CENTRE.

good polish. The filings consist of hardened steel powder which has been sifted. The sensitiveness, according to Professor Braun, is equal to the best vacuum nickel-silver coherer, and its reliability is much greater. The rougher the steel filings the greater the sensitiveness, but this is obtained at the expense of accuracy.

Professor Braun has made the observation that the steel coherers do not fulfill the requirements of accuracy when the conductor plugs become magnetic, but that a certain critical degree of magnetism enhances its sensitiveness without injuring the accuracy of cohesion. This phenomena led to the invention of a magnetic regulator, doing away with the fault of the former and using it to advantage for the latter. This is done by means of a permanent ring magnet placed near the conductor plugs and between them; by turning the magnet ring the north or south poles may be brought as near the ends of the electrodes as desired and the surface contacts of the conductor plugs will be magnetized or demagnetized to whatever extent is determined best for the purpose.

The apparatus also includes a tapper for decohering the filings and a Morse printer, shown to the extreme left in Fig. 1.

The photograph, Fig. 1, is the interior of the Siemens & Halske station at Heligoland, which is on one of the Frisian Islands in the North Sea, 54 degrees 11 minutes 34 seconds north latitude, 7 degrees 51 minutes east longitude. Fig. 6 is the exterior of the same station. Fig. 7 shows the guests who were invited to witness the first exchange of wireless messages between Heligoland and Cuxhapen, where the opposite station is located. The distance between the two points is thirty-six miles.

Water-Wheel Irrigation, Driven Electrically.

Hydraulic mining having been prohibited by the National Government in many parts of California, the hydraulic development companies are very profitably turning their attention to power and irrigation projects. The Central California Electric Company has recently purchased two 1,000-kilowatt Westinghouse alternating-current generators, which will be direct-connected to water-wheels and used to supply power to Grass Valley, Nevada City, Sacramento and adjacent towns. This is the third station to be installed by the company, two other stations having now been in operation for a number of years. The Central California Electric Company's system is a part of that of the South Yuba Water Company, which controls 400 miles of main ditch line, in the heart of the Sierra Nevada Mountains. Formerly the water was used for hydraulic mining, but this having been stopped on account of the filling up of the rivers with "slickens," the water now is sold to ranchers and fruit-growers for irrigation purposes. Before being sold to the farmers, however, it is transmitted in pipes to stations at different points along the system where electric energy is produced, and conducted thirty-five to fifty miles to adjacent cities.

Another Magnetic Pole Expedition.

Word comes from Copenhagen, Denmark, that Amundsen, the Norwegian explorer, has planned an expedition for next year to carry out the researches in connection with the magnetic pole discovered in 1831 by Sir John Ross, but which is now believed to have changed its position. Amundsen will charter a small schooner called the Gjora, he believing that a small craft is best adapted for such an expedition. The start will be made next spring with seven companions from the west coast of Greenland, through Baffin's Bay to Lancaster Sound, the idea being to make many observations in connection with the magnetic pole. It is expected that the expedition will return in 1905.

THE CONSTRUCTION OF TELEPHONE EXCHANGES—XXXVI.

BY A. E. DOBBS.

LOCATING LINE TROUBLE BY TESTING.

A cross in almost any part of the line would virtually short-circuit the generators, provided the contract was a good one, and prevent signals from actuating any other bell or throwing the drop at the exchange, for, though there are drops on the market that will fall when shunted by a resistance of 100 ohms, yet when we consider that in this particular line we have considerable line resistance and the other bells also taking away part of the feeble current that remains, it is doubtful whether any subscriber could call or be called. Here is where the manager, by comparing the readings of his test set with readings previously obtained, can often get a fair idea of the trouble and its location without waiting for the operators to call in, even if the line should be looped into the stations, as it generally is not.

OPEN WIRES.

But there is another possible source of trouble that may deceive him should it occur at night or any other time when the station agents or operators were not on duty, and that is, an open circuit. In the line under discussion the cutting out of one or two bells would not interfere with the operation of the rest—it would help them rather than otherwise—except that the stations beyond the break would be cut off from the main office. The distance to this break can be more easily calculated than a cross by the rise in the resistance of the line, for every bell cut out increases the resistance as measured from the controlling office.

Suppose we have a break between stations 3 and 4. During the busy hours No. 3 could be called as usual, while No. 4 could not, but at times there might not be any one at either of these stations to answer calls, while perhaps No. 4, being a switching office, might be more important than any of them. For this purpose a set of tables might be made to indicate the combined resistance of the bells with one or more stations cut out, calculated as before indicated.

TABLE V.

With break between	Nos. 3 and 4 =	508 ohms.
" "	Nos. 2 and 3 =	605 "
" "	Nos. 1 and 2 =	1085 "

This can be estimated by beginning at the outer end and working back toward the office as already indicated. Thus, to calculate a break between stations 3 and 4, we have:

(*a*) $\frac{1}{1,600 + 119} + \frac{1}{950} = 0.000582 +$
$0.001053 = 0.001635 = 612$ ohms.

(*b*) $\frac{1}{612 + 119} + \frac{1}{1,000} = 0.001368 +$
$0.0091 = 0.002368 = 423$ ohms.

(*c*) $423 + 85 = 508$ ohms—*Answer*.

A break between Nos. 2 and 3 can be worked out in the same way, while one between Nos. 1 and 2 will be simply that of the five miles of line resistance and the station bell; 85 + 1,000 = 1,085 ohms.

None of these measurements would indicate the distance to the break, however, but Fig. 153 shows the same line with a break between stations 1 and 2. A test of the line would show 1,085 ohms, which would indicate that No. 1 was still in circuit, while a test to ground from either side would show that one end was lying on the ground, but the open side would show a much higher resistance than the other, because the current would have to pass through the 1,000-ohm bell at station 1. In our first example we found the combined resistance of bells and line belonging to stations 2, 3 and 4 to be 445 ohms. Suppose that a measurement to earth showed 600 ohms, we know that the resistance of the twelve miles of line to station 2 is 102 ohms, so 445 + 102 = 547 ohms for the line.

Deducting this 547 from 600, leaves 53 ohms as the resistance between No. 2, and the ground, which, if the ground should be a good one, would indicate a distance between five and six miles back from No. 2. If the wire in breaking down should cross its mate, the resistance would be cut down to probably 100 ohms or less, being simply that of the wire and the additional resistance of the ground connection.

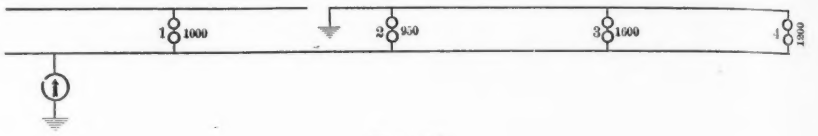


FIG. 153.

In Fig. 154 we have the line broken and grounded toward the office end, in which case it would be simply a matter of finding which wire was grounded and measuring it at the rate of 8.5 ohms per mile, with the exception that the three bells would be the means of adding a second conducting wire between Nos. 1 and 3, which would lower the resistance of the wire enough to indicate the trouble about a mile nearer the office than it really is.

So far we have considered only one line, that under the conditions laid down in Fig. 149, Figs. 153 and 154 being merely variations of the same.

In Fig. 155, however, we have wires of the same resistance—8.5 ohms per mile—but the bells are all of the same resistance, being 1,000 ohms each. We also suppose a cross between the two circuits twenty miles down the line, the resistance of the loop so formed being 340 ohms, but along down the line we find that even though one side of No. 1 circuit is left open at the office, yet the two sides are joined together by stations 1, 2, 3 and 4, which, of course, would add a second conducting path and lower the resistance of the lines indicated, these stations are four, five and three miles apart respectively, and by considering two of these bells as leading the current on the other side of the wire and two more as leading it off, we can strike an average length of line affected by their conductance, which would be half the distance between Nos. 1 and 2, all of the distance between Nos. 2 and 3, and half that between Nos. 3 and 4, which would be 8.5 miles. The combined resistance of the first two bells would be 500 ohms; that of the second two bells 500 ohms, or 1,000 ohms in all.

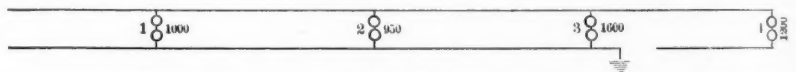


FIG. 154.

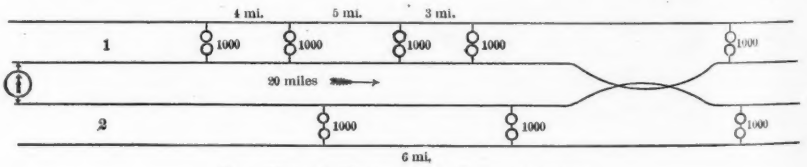


FIG. 155.—A CROSS WITH COMPLICATIONS.

The resistance of this loop, therefore, could be practically considered as 1,000 ohms of bell and 72 ohms of line resistance, or 1,072 ohms in all, the reciprocal of which is 0.000933. The resistance of the single wire for the same distance is 72 ohms, the reciprocal of which is 0.014. Therefore, $0.014 + 0.000933 = 0.014933 = 67$ ohms instead of 72 ohms, a reduction in this leg of five ohms.

On circuit No. 2 we have a similar condition, except that there are only two bells in circuit six miles apart. The stray current passes through bell No. 1 on to the other wire and out again through bell No. 2, the two bells and six miles of wire having a resistance of 2,051 ohms, the reciprocal of which is 0.000487. The resistance of the straight line for this distance is 51 ohms, reciprocal 0.019608; joint resistance $0.019608 + 0.000487 = 0.020095 = 49.7$ ohms, a lower resistance of 1.3 ohms for No. 2 circuit, or for both sides of the circuit 6.3 ohms, so that, instead of measuring 340 ohms, it would measure 333.7 ohms.

These problems seem very complex, as indeed they are, and they belong to a class the writer has not as yet been able to find in any published books; but every one who has to deal with lines of this kind will recognize them as very practical, everyday examples, even if treated from a theoretical standpoint.

An exchange manager could, by sending a man over the line to cut, cross or ground it at the different stations, obtain a set of constants that would be of more or less service to him, but if he can obtain a theoretical value for the different tables herein given, and afterward check them up by frequent tests, he will be in a better position to know the actual working conditions and calculate for possible sources of error.

INSTRUMENTS TO USE.

In the measurements of resistance it is not necessary to purchase an expensive outfit costing several hundred dollars, though that would be very desirable, but in a pinch a manager can get along with much less than a laboratory outfit and the electrician often has to rely on his wits to help him out of a tight place or to obtain necessary information. A great many exchanges do not possess a testing outfit, but much information can be extracted from the intelligent use of even a pocket voltmeter provided it is a standard instrument and its resistance and *current constant* are known. Next to a bridge and galvanometer this affords the most reliable means of finding the approximate resistance, so that some engineers engaged in electric light work make use of a high-grade voltmeter altogether in all of their ordinary work. By current constant is meant the current necessary to deflect the voltmeter one degree of the scale, whether the scale be marked in divisions of volts or one-tenth of a volt.

To obtain this constant it is necessary that the resistance of the voltmeter coils should be known, either from information obtained from the manufacturer, or by measurement on some other instrument.

Let us suppose that we have a voltmeter measuring 100 ohms with a scale marked in tenths and we use a battery of three cells and get a deflection of 4.5 volts, which is equal to forty-five divisions on this scale. By Ohm's law $\left(\frac{E}{R} = I\right)$ we have $\frac{4.5}{100} = 0.045$ of an ampere as the deflection of forty-five degrees of the scale, from which it follows that one degree of the scale must equal 0.001 of an ampere, or one milliampere. The current constant of this voltmeter, then, is one milliampere.

Let us now, using the same battery, connect the voltmeter in series with an unknown resistance and in so doing find that the pointer has fallen off ten scale deflections, or ten milliamperes. Our voltage we know to be 4.5, our current 0.010; therefore, we call upon the second term of our formula $\left(\frac{E}{I} = R\right) = \frac{4.5}{0.010} = 450$ ohms. Deducting the resistance of the voltmeter (100 ohms) leaves a net result of 350 ohms as our external or unknown resistance. A voltmeter reading to five volts as described would not indicate the voltage of more than three or four cells of battery, while for measuring high resistances it might be necessary to use from fifty to seventy-five cells.

It is quite possible, however, to get around this difficulty in another way—by inserting a resistance or multiplier in circuit with the voltmeter. Our voltmeter resistance is, say, 100 ohms. By placing a resistance in circuit of 900 ohms we increase our circuit resistance tenfold and our voltmeter reading in the same ratio, so that if we now get a reading of 4.5 volts, we know that the battery pressure is really forty-five volts. Now, by disconnecting this resistance and connecting our unknown resistance in its place, we can get the reading directly on the voltmeter as before, provided the resistance of the unknown is not so low as to cause the voltmeter to run off the scale or burn out the coils.

The following table indicates the possibilities in the use of a cheap voltmeter such as already described:

Resistance Ohms.	Ratio.	Volts. Limit.	Scale in Tenths.	Highest Range Without Multiplier. Ohms.	Lowest External Resistance.
Voltmeter, only, 100.	....	5	50	4900	.....
Series 900.....	10-1	50	50	49900	900
" 1900.....	20-1	100	50	99900	1900
" 2400.....	25-1	125	50	124900	2100

Column 4 indicates the reading in scale divisions which, as the scale is divided into tenths, indicates five volts as the limit of the instrument. Column 5 is the highest possible resistance that can be measured by the voltage given in column 3, while column 6 is the lowest resistance that can be measured by the voltage given, and is the same as that of the resistance in column 1.

It must not be thought that because the writer speaks of the possibilities of a cheap voltmeter that he commends their use by any manner of means, but the object is to show some of our friends how to make a virtue of necessity. There are voltmeters that have a reading or current constant much higher than 0.001 of an ampere—0.0001 is not uncommon—which can consequently be used to measure insulation running up into megohms.

Instead of using resistances for checking up high voltages a better plan is to use a high and a low-reading voltmeter, if they can be obtained, making sure that the two read alike. When a high-voltage battery is necessary, it is measured with a high-resistance voltmeter and the reading then taken with the low-reading instrument on account of its greater sensitiveness.

ANOTHER POINT.

Telegraph men insist upon having first-class and reliable instruments for their tests, but telephone managers sometimes exhibit a tendency to buy the cheapest sets offered them, only to find out afterward that it is a difficult matter to get two readings alike through the same circuit. Every exchange should possess a voltmeter, a good zero galvanometer and Wheatstone bridge, for there are many uses for such instruments, and the manager who possesses them will easily get his money's worth by intelligent use of them.

The Ventimiglia-Bordighera Electric Tramway.

Description of a New Italian Trolley Road.

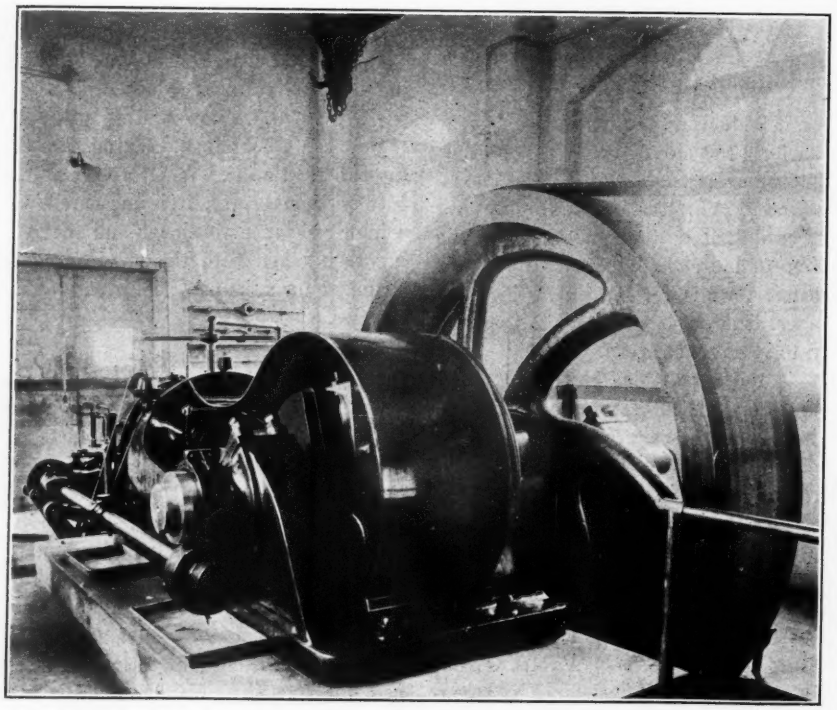
By Enrico Bignami.

THE Ventimiglia-Bordighera electric tramway was opened to public use at the beginning of this year. This road joins the last Italian city on the Mediterranean, and which borders on France, with the first of the most beautiful countries of Liguria, a favorite winter resort, particularly for British families. Here there are many villas, large hotels and charming views of the Cornice, of Antibo, etc.

The road has been built by the firm of Woodhouse & Baillie, which is the same company that furnishes electrical energy for light and motive power to the two above-named localities. The line follows for the most part the provincial road, except for a space of 250 centimetres, where it has a private right of way. Here there has been erected a bridge over the Mediterranean Railroad. This is composed of iron girders resting upon piers of masonry, and approached on the west by a viaduct composed in part of seven spans of reenforced concrete. The length of each span is five metres.

The power for the tramway is generated at the electrical power-house of the same company in Ventimiglia. This is about 600 metres from the head of the line in that city. The total length of the line is 5,750 metres. The cars accommodate twenty-eight passengers and were furnished by the Diatto Company, of Turin. They have been equipped electrically by the Alioth Company, of Bale. Each car is provided with two twenty-horse-power motors, and four cars give a fifteen-minute service each way. The car-shed is in the middle of the line and close to the viaduct. Here there has been installed in addition a battery of accumulators which usually operates in parallel with the dynamos at the power-house. The batteries, which have been furnished by the Tudor Company, of Genoa, have a capacity of 129 ampere-hours. By its central position it is able to regulate the voltage of the line and also to diminish electrolytic phenomena.

VIADUCT OF REENFORCED CONCRETE ON THE VENTIMIGLIA-BORDIGHERA TRAMWAY.



THE STOCKPORT GAS ENGINE OF 90 HORSE-POWER IN POWER STATION AT VENTIMIGLIA.

The overhead trolley system has been adopted with a wire nine millimetres in diameter. There is no feeder. There are two dynamos at the power-house, each of eighty-five amperes capacity at 600 volts. These were furnished by the Alioth Company, of Bale. In operation, but one of the dynamos is used, the other being held in reserve. Either dynamo may be operated through a friction clutch by means of a turbine or a gas engine using producer gas. The power-house contains two turbines of seventy horse-power each, and

two gas engines of eighty horse-power. The turbines were made by the firm of Riva, Monneret & Company, of Milan. The gas motors were furnished, one by the firm of Crossley, and the other by Andrew, of Stockport. The producer gas is furnished from two generators of 150 horse-power each.

The current for the tramway is normally generated at a tension of 600 volts, and the pressure at the battery varies about 550 volts.

The Battery Room at the Car Barn Containing 275 Cells—Ventimiglia-Bordighera Electric Railway.

The line is for the most part level. The steepest grade is on the viaduct, and is about five per cent. According to plans which are already under consideration, this line is intended to connect at the one end with that which already joins Monte Carlo with Nice, and at the other with that at San Remo.

An interesting project is said to be on foot for supplying the city of St. Petersburg and suburbs with current for light and power distribution. The project, which has been devised by M. Dobrotvorsky, a prominent engineer, is backed by a number of capitalists. The hydraulic power of three great lakes in the surrounding region is to be used. These lakes, Saima, Paipus and Ilmen, flow into the sea by the rivers Volkov, Narva and Vuoska respectively. The River Volkov has rapids which can develop nearly 40,000 horse-power, situated about sixty-six miles from St. Petersburg. A dam placed across the river will give a head of water equal to forty feet. It is proposed to utilize this fall for a large hydraulic plant which will contain eighteen turbines, each of which will be direct-connected to three dynamos of 500 kilowatts. The second river, the Narva, would in like manner afford a fall of thirty-five feet at a point about eighty-four miles from the city, and a similar turbine plant would be erected here. The total energy of the fall is estimated at 30,000 horse-power. The third plant would utilize the rapids of the Vuoska and the fall of a neighboring stream, the Imatra, the total to give 37,000 horse-power. The high-tension lines from the three plants would be brought together in a main station at St. Petersburg, and from there would proceed the low-tension circuits for the city lighting, motor distribution and tramways. M. Dobrotvorsky estimates the total amount of energy to be used in St. Petersburg at 47,600 kilowatts, allowing for 300,000 incandescent lamps, taking 16,800 kilowatts, and 4,000 arcs at 3,200 kilowatts; the tramways would take 3,600 and the power circuits 25,000 kilowatts. It is stated that the company, which has been recently formed, has already obtained the necessary concessions to carry out the project, and that the total expense will exceed $14,000,000.

The Producer Gas Generators at the Power Station in Ventimiglia.

The Society of Model Engineers, London, England.

On Thursday, July 17, a party of members of this society paid a visit to the Rugby works of Messrs. Willans & Robinson, Limited, the well-known makers of high-speed engines. The opportunity of inspecting such a well-organized and up-to-date establishment was much appreciated by the members, who evinced great interest in the tools and methods adopted to secure the accuracy of workmanship and interchangeability of parts. The party were subsequently received by Mr. Lazenby, on behalf of the firm, and entertained to tea. Earlier in the day the society paid a visit, by the courtesy of Mr. F. W. Webb, to the locomotive running sheds of the London Northwestern Railway, under the personal guidance of Mr. C. J. Bowen Cooke. Votes of thanks to those who had so kindly extended the various facilities to the society were proposed by the chairman, Mr. Percival Marshall, and cordially adopted.

An Old Engine's Resting Place.

A Watt engine which had done service for 102 years was removed lately from its sphere of usefulness to a London museum. In the old days substantial work must have been done or this engine could not have lasted so long. It is believed that the oldest engine now in service is one at a colliery near Rutherglen, Scotland. This is a Newcomen engine erected in 1802. Since that time it has been in continuous service and has needed no important repairs. Brasses, of course, have had to be replaced, and a wheel or two, but otherwise the engine needed no fixing, and still is in good repair.

DEPRECIATION IN TELEPHONE PROPERTY—II.

A SERIES OF PAPERS ON AN IMPORTANT TELEPHONE PROBLEM.

BY FRED DE LAND.

During the session of 1899 the Michigan Legislature created the Board of State Tax Commission, and made it a part of its duties to ascertain and report to the legislature the actual and correct values of telephone and certain other corporations. Professor M. C. Cooley, of the University of Michigan, was employed as appraiser to have charge and complete the work of affixing values of physical properties. In determining the appraisal two distinct values were recognized. First, the tangible value or values of physical properties; second, intangible values, consisting of franchises, rights of way, and other elements which enter in to make a large increase in earning power. The tangible values were under the direction of Professor H. C. Adams, of the University of Michigan, and United States statistician for the Interstae Commerce Commission. After a long and thorough study of the problem, annual depreciation charges were allowed by this state board, as follows: Poles and cross-arms, accepting about twelve years as the average life of a pole, a depreciation was allowed of eight per cent per annum; underground conduits, two per cent; underground and aerial cables, lead-covered and rubber, ten per cent; subscriber's station equipment, ten per cent; switchboards, ten per cent. For copper wire in use one year or less, its full value will be taken; for two years and less than three years, two and one-half per cent; for three years and less than five years, five per cent; for five years and less than ten years, ten per cent; for ten years and over, twenty per cent. This makes an annual average of about eight per cent.

On December 23, 1895, the executive committee of the Milwaukee Telephone Users' Association, after a thorough investigation "into the reasonableness of the charge for telephonic service in Milwaukee, reported, among other facts, that a very serious problem in the telephone business is ascertaining the correct amount which should be charged off every year to offset the depreciation of the plant from use and age. The telephone company advises us that in its experience, and before the present Milwaukee plant (which is practically entirely new) was installed, the cost of maintenance approximated twenty per cent per annum; but with the substitution of new and improved methods of construction a certain degree of permanency must be assumed, and the present cost of maintenance is estimated to be ten per cent per annum. This, of course, is applicable only to the plant proper, and has no application to real estate or franchise. A detailed statement showing the estimated life of the several parts of the plant is given. The officials are of the opinion that this cost of maintenance is understated." The detailed statement of estimated yearly depreciation in this new plant reads in part as follows: "Subways, including manholes and submarine pipe, five per cent depreciation; cables in subways, including cables to cable heads in building and all submarine cables, six and three-quarter per cent depreciation; distribution from subways, both methods, twelve and one-half per cent depreciation; aerial construction, new poles and lines complete, aerial cables included, ten per cent depreciation; switchboard, cross-connecting board, and cable to cable heads and arresters, twelve and one-half per cent depreciation; subscribers' equipment, ten per cent depreciation; live and rolling stock and tools, ten per cent depreciation." This makes the average nearly ten per cent.

That certain progressive independent companies follow the practice of the Bell, and, when doing new work of the same class of construction as the old, like the rebuilding of an aerial line, charge direct to the maintenance account a due proportion of the several items of cost, sufficient in the aggregate to cover the cost of the old work, less the value of the old material used upon the new work or turned into the supply department, is shown in the following extracts from different reports:

Mr. Fisher's company, the Citizens' Telephone Company, of Grand Rapids, Mich., which commenced to supply service July 1, 1896, stated in 1901 that "reconstruction, which has been enormous, has been charged to operating expenses; some poles have been moved three times; we have had to put aerial lines in conduits, etc.; all this goes to operating expense." And in his annual report to the state officials, made about one year after his company commenced supplying service, Mr. J. B. Ware, general manager of this company, made the following entries: "A ten per cent discount of poles should be made, being annual depreciation; annual depreciation on wire, probably ten per cent; cross-arms cost $1,950; depreciation, $450 (23 per cent); insulators cost $756; depreciation ten per cent, $75.60; batteries, depreciation $400, sixty-six and two-third per cent nearly worn out; tools cost $600, depreciation $200, or thirty-three and one-third per cent."

The Rochester Telephone Company, Rochester, N. Y., states that "the operating expenses . . . cover all charges including maintenance of plant, the rental of conduits, insurance, etc., yet do not cover depreciation. For this it is estimated that ten per cent per year will have to be allowed on the value of the overhead work, though a very small sum will suffice to cover the charge for conduit work."

Mr. F. W. Dunbar, an independent telephone engineer, in preparing an estimate of the cost of installing a plant of 2,000 stations allowed annual charges for maintenance and depreciation as follows: "On subscriber's set installed and wired to outside system, $5 each, or thirty-one per cent; on subscriber's terminals, forty cents each, or ten per cent; on switchboard complete, ten per cent; on cable terminals (heads) and connections to distributing board, five per cent; on cables, four and one-half per cent; on ducts, three per cent; on aerial construction, fourteen and one-half per cent, or $2.72 per station."

Mr. Franz J. Dommerque, an independent telephone engineer of wide repute, told the members of the American Institute of Electrical Engineers, on March 28, that "the depreciation factor on the plant should not be taken too low, as there are so many unforeseen incidents such as blizzards menacing pole-lines, new inventions making switchboards obsolete, etc., that may deplete the treasury in a short time. The allowance for depreciation should not be below ten per cent on the switchboard; fifteen per cent on open-wire pole-line; four per cent on conduits; twelve per cent on cables."

Mr. Kempster B. Miller, the representative of what is probably the largest independent telephone manufacturing company, told the members of the New York Electrical Society that the "other matters to be considered in the preliminary layout of a telephone system are: Annual cost of operation, including salaries of operators and the cost of current supply; fixed charges and rent, including interest and depreciation on the office equipment, interest and depreciation on the wire plant, interest and depreciation on the subscriber's apparatus and annual

cost of maintenance. These factors, unlike the first mentioned, are subject to predetermination with a fair degree of exactness."

Mr. F. C. Redfield, the well-known independent manufacturer, in referring to the "cost of running the plant," wisely said, "presumably all companies know this cost. It should include everything, rent, light, heat, taxes, insurance, operating, maintenance, etc., but not construction. To all this should be added a six-per-cent dividend on the capital stock of the company and an annual depreciation of ten per cent on aerial construction (including everything above the ground), and five per cent on underground construction. Many independent companies make no account of depreciation, but pay large dividends. In this they are making a mistake; they are simply fooling themselves, and their stockholders will realize it some day. It is conservative management to figure depreciation as above, and in all cases it should be taken into account in figuring actual cost of doing business."

The following extract from the sworn testimony of an official of a telephone company covers some of the minor features:

The office wiring very rapidly depreciates; especially is that the case where high-grade insulation is necessary on account of our metallic circuits; we are compelled to run wire into all sorts of places and the deterioration in some instances forces us to completely rerun the wire in six to eight months or a year. How long the magneto bells will last depends on the use made of them by the subscribers. We have been compelled in two or three years to replace them entirely, as to the field magnets or ringer magnets, and almost entirely remodeled the bells. There are other cases where the bells last five or six years in cases where the number of calls per telephone is limited. In certain portions of the switchboard the deterioration is very great. Especially does that apply on the multiple spring-jacks where they are plugged into thousands of times. The plug being of metal and the spring-jack being of metal, we are called upon to place springs in the plug to enlarge the surface and make it fit closely to the spring-jack. The wear in these jacks, I should say, would be about fifteen per cent per annum. The drops do not generally depreciate so rapidly, because they are only called upon to respond to each ring. They are not plugged into, and there are no pieces of metal coming together to wear them out. The lifetime of the drops is between eight and twelve years.

That other lines of industry have similar experiences is well known. Following is an extract from the report of a well-known accountant: "Mining machinery is apt to require renewal at short intervals of time, and more apt to prove of little value when its term of service is ended, and for this reason, so far as the business of metalliferous mining is concerned, the total expenditure for, and the entire cost of, all mining plants and machinery may be regarded as a part of the gross expenditure fairly chargeable against the gross income of the business. A just balance of profit and loss can not in the end be arrived at unless this item of expenditure is so considered."

Here are some extracts from the published annual reports of six Bell companies that are not only interesting, but serviceable in showing past experience:

First—During these fourteen years there has been an average annual charge of $130,927 included in the annual expense account and expended solely in improving the plant.

Second—The construction forces were employed to reconstruct several of our large exchanges, and rearrange the plant to accommodate the rapid increase of subscribers. A large portion of the cost of this work has been charged to maintenance, namely, $31,460.63.

Third—The introduction of this new system necessitates large charges against our earnings account to cover reconstruction costs, and a proper allowance for depreciation in value of the replaced apparatus. The charges against reconstruction and maintenance account (taken from the earnings) for the year 1900, amount to $847,684.63 (including this charge, the operating expenses amount to $2,018,603.24).

Fourth—Continuing the policy adopted in past years, your directors have charged to contingent fund the sum of $150,000, which, less amount expended during this year (1897) on construction, rendered necessary by the introduction of trolley and other strong current wires, but which has not increased the earning power of the plant, leaves a balance of $800,000 in contingent fund.

Fifth—The cost for maintenance and renewal of the plant continues to be the largest of our current expenses, somewhat more than one-third of the gross revenue being required for that purpose. We find no ground for belief that this ratio of expenditure can be materially lessened. In addition to the labor and material necessary to maintain the existing property in effective condition, the work of replacement is constantly going on, as portions of the property become unserviceable.

Sixth—In some of our larger exchanges the growth of the last few years has been so great as to make it necessary to provide new systems of central office operation, if our former high standard of service is to be maintained. . . .

These changes in central office systems involve much work upon the outside plant to adapt it to the new methods, and while the work is in progress there will continue to be large charges against the earnings account for cost of construction and for depreciation in value of the replaced apparatus.

Seventh—The expenditures have been largely increased not only by the growing cost of operation, but also through the necessity of replacing old switchboards and apparatus with new and improved equipment, in order to maintain the quality of the service at the highest modern standard. New switchboards and apparatus were installed during the year, costing $282,160.38. The apparatus thus displaced stood upon the books at actual cost of $321,800; deducting its appraisal value for removal, $46,800.40, makes a loss to the company from these changes of $274,999.60. Such changes are inevitable and will continue until all the apparatus used in the exchange is of the type of the latest stage of the art, in which invention is constantly making such wonderful progress. To provide for such contingencies, and for continuing depreciation in its underground cables and plants, an account stands on the books styled "Reserve for Deferred Maintenance," and from year to year a portion of the earnings has been carried to the credit of that account. The cost of the changes above given for the year 1900 has been charged to that account, and there still remains a balance to provide for similar changes in the future.

Eighth—During the past year (1900) a new plant (common battery system), with the exception of the subways and underground cables, pole-lines and wires, has practically been installed, and many of the pole-lines and wires rebuilt and extended, putting them in the best possible position, new switchboards, exchange apparatus, and subscribers' station outfits were substituted for the old equipment and all subscribers' stations rewired.

Our second phase of depreciation is the diminishing value in the assets of a plant due to improvements in the art, rendering it necessary as well as economical to replace old with improved equipment, and to rebuild and make metallic all circuits, notwithstanding circuits and equipment are comparatively new and have seen relatively but little service.

A bank official, commissioned to obtain exact information on the telephone question, states: "The general manager of the Bell in St. Louis said to me: 'We are all on nettles lest something comes along which may make our plant antiquated. The uncertainty of our position is much less than it was ten years ago, yet there is still uncertainty. Our fears are due not to the possibility of quicker service, for that is now practically instantaneous, but to the possibility of

cheaper methods being introduced.' There is no denying the truth of this statement. It holds good of almost every business; it is a part of the speculative element entering into every commercial enterprise. But men continue to build trolley lines, even though aerial navigation seems feasible at a time not very remote, and they still buy steam engines, though the latent energy in the tides may be made available at any moment. And telephones are going to be set up, even though, some day, a cheaper device may be invented. The way to deal with contingencies of that kind is to have the possibility reflected in the price charged for service given."

Only a year ago the Illinois Telephone and Telegraph Company issued a circular reading: "The value of the telephone of to-day is in the number of subscribers and the efficiency of its service. The telephone instruments and appliances now in use are antiquated. This is an age of progress and improvement, and equally rapid strides have been made in the development of the telephone, as of every other device and invention in general use, but the very large amount of money already invested throughout the country in the old-style instruments and switching devices, and the immense sacrifice that would be caused to the existing telephone company by abandoning and throwing away these devices and substituting for them the more modern ones, has deprived the public of the benefit and advantage of these modern improvements which it should have enjoyed long since, at a price much less than the present rates, and without the arbitrary conditions imposed under the old (the present) system."

It may be claimed by enthusiastic newcomers in the telephone field that so great has been the improvement in independent apparatus that the necessity for junking equipment by reason of the introduction of new and improved forms of apparatus, better adapted, no longer exists. But an hour's study of the advertising circulars sent out by thirty or more manufacturers of telephone and switchboards will show the fallacy of such reasoning. Moreover, every ambitious manufacturer is striving to improve his equipment; he must do so to keep in the race. Mr. Clement has shown how "in telephony proper, as we know it, there will be many changes. The switchboard of to-day is a crude conception. Cords are clumsy connectors and inefficient. . . . Transmitters will doubtless change materially." . . . Mr. Duval says: "Some buyers in the independent field are apt to complain of the number of improvements and new styles of apparatus being placed on the market from time to time by the different manufacturers. This should not be, as the independent field has been in a state of evolution since its conception. It is only by this ceaseless improving that the independents have made a market for high-class apparatus, which is a source of surprise to the Bell interests."

All modern telephone exchanges in the United States use vertical switchboards, because American practice and experience have shown that the vertical type possesses many advantages over the horizontal type formerly in use in many exchanges. But now an improved form of horizontal board is being installed in certain German exchanges, and if all the claims made in its favor can be substantiated, this type, or an improved modification, may yet displace all the expensive multiple boards recently installed in the United States.

But such displacement would be no more remarkable than many of the changes that have occurred in the past. Dr. Lumpkin told the delegates to the Chicago convention what the conditions were "seven or eight years ago. In order, then, to buy a switchboard you must send your money to the company, and after receipt of your money, they would take plenty of time and plenty of wood and build you an immense piece of furniture and send it to you labeled a switchboard. The fact was, however, you must take this crude and cumbrous piece of furniture and construct your switchboard out of it yourself. By the time we made over our board you could not recognize it. This board must be installed in a back room with no outer door-knob, only a night lock attachment, so that no Bell man could enter to inspect the infringing parts—without he came with a search warrant. And they all infringed. Even the pulleys on the cords. The Utica people would not put pulleys on the cords, but we did. Who of you in those days did not? It was a direct infringement against a Bell patent." And Mr. E. H. Andress gave the delegates to the La Fayette convention a clear description of the crude apparatus used but seven years ago by the independents.

We started in on January 1, 1895, with 300 subscribers. The plant has steadily grown, and now we have over fifteen hundred telephones in everyday use. Parties starting in now have a much easier task than did we pioneers. We had scarcely more than two or three places to get material. Our first outfit from start to finish was very crude. I will give you a partial description of it. For fear I might make some mistake or misstatement, I have jotted a few points, and will read them to you. First, our switchboard—tin shutters. Rusty iron plunger rod to kick down the shutter. Cotton-covered wire on drop coil; all wiring done with cotton-covered wire. Jacks made of iron castings and pewter springs. Plugs, metal and rubber, poorly put together. No protection. Home-made distributing board. Cheap, indifferent generator, always in series upon line. Manual switch-hook pulled down by hand and held by a ratchet. Transmitter made of a thin shingle with a knife carbon glued horizontally. Three carbon fingers hanging perpendicular, lying against knife blade. Could not use when any vibration in building. Receivers the shape of a bar of Babbitt's soap; diaphragm the same shape. Opposite poles of permanent magnet three inches apart; internal action always present. Lay the side of the receiver to the side of the ear. All junk.

Lighting Cars with Electricity.

[*From the N. Y. Daily World.*]

Another accident in the West in which a railroad wreck caught fire with the result that several persons were cremated whose lives otherwise might nave been saved, calls attention anew to a condition which, as the *World* has repeatedly pointed out, has the remedy immediately at hand.

The lighting of railroad trains with gas or oil is a relic of the past and should not be tolerated longer. Efficient and economical electrical appliances for lighting the cars are being used on the finest and fastest railway trains. The explosive gas tank and the deadly oil lamp have been relegated to the scrap heap on many of the up-to-date railroads; and in the interest of the safety of the traveling public electric lighting should become universal. If the railroad companies fail to look after their own best interests and extend this protection state and national legislation will, in the end, compel them to do so.

The Pennsylvania Street Railway Association.

The next annual meeting of the Pennsylvania Street Railway Association will be held at York, Pa., on September 10, next. The officers of the association are: President, John A. Rigg; secretary, John Ruth; treasurer, W. H. Lanius. The executive committee is as follows: John A. Rigg, William B. Given, B. F. Meyers, W. H. Lanius and S. P. Light.

Mr. H. J. Titus, a steward on one of the "Alton's" dining-cars, recently had for a guest a gentleman to whom he unconsciously gave such polite attention as to attract his patron's notice. Upon arrival of the train in Chicago, this passenger, who was a high official of the Mobile & Ohio Railway, repaired to the general offices of the Chicago & Alton Railway, and, being assured of Mr. Titus's ability, promptly appointed the latter superintendent commissary of the Mobile & Ohio Railway. Mr. Titus assumes his new duties August 15, with headquarters in Jackson, Tenn. He will be the youngest railway superintendent of dining-cars in the United States, his age being but twenty-four.

Electrolysis of Pipe Lines.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of July 26 you published a letter criticising the opinion expressed by the *New York Times* and certain correspondents of that paper. In some respects I wish to differ from the views expressed in the above referred to letter.

An important question asked by the *New York Times* was: "When was it discovered that electricity is destructive of a good conductor?" That question has not been met, in my opinion, by your correspondent. If conditions of current, etc., remain the same, a good conductor is not so much affected by electrolysis as is a conductor less good; it surely proves that the better the conductor the less the electrolysis. If this argument is true with conductors then why is it not true of pipe lines? Years of practice have shown that where the rails of street railway tracks have been properly bonded, the rails themselves have not suffered from electrolysis, or shown evidences of it in any way. If this is true of the rails in the ground, why should another law have to be found for treating the pipes under the ground. One of the reasons why the rails do not suffer any considerable depreciation owing to electrolysis is that under normal conditions there is not set up between adjacent rails an electromotive force sufficient to produce serious electrolysis, and this is obviated by having all rails properly bonded. Now, by parity of reasoning, if all pipes lying within the zone of action of a certain street railway system were joined so that for all practical purposes they formed one continuous metallic conductor, and then these pipes were connected to the return current feeder at the power-house, I firmly believe that no trouble would occur to the piping from electrolysis, but owing to the necessity for repairs and the certainty that bad joints in lengths of pipes will develop from time to time, it is desirable to have a return feeder to which pipe lines should be connected as often as it is found necessary. This precaution would minimize any trouble likely to occur from electrolysis owing to bad joints in the pipes, as it would offer an alternative route of low resistance for the passage of the current.

Those having any considerable experience with street railway work know how difficult it would be, assuming that the owners of pipe lines would permit of their pipe lines being broken up and rejointed, to have to relay underground pipes with insulating joints, especially when one considers the complicated network of pipes found under city streets.

A simple method of making an electrical pipe joint is to score the spigot and socket with a chisel, so that when the lead is run in and tamped up, good electrical connection metal to metal is made. As I have before said, there is no necessity that any serious electrolysis of underground piping should occur in any properly designed system of electric traction for street railways.

One aim of the engineer, I think, should be not to try to prevent stray electric currents from entering pipes, which is practically impossible, but to ensure that current entering any pipes may be carried to its proper destination without causing trouble. To do this, the pipes obviously must be made good conductors.

I think that the *New York Times* deserves much credit for taking up this question in the manner it did, and if members of our profession would only see what is good in articles such as these, instead of picking out slight inaccuracies that may have crept in, it would be more to our credit. Nothing is easier than to tear to pieces the average technical article, even though it be written by an expert, and I am sorry, therefore, that your correspondent considered it necessary to make so much of the inaccuracies that appeared in the article in the *New York Times*, which inaccuracies did not bear materially upon the main question under discussion; they did not deceive the engineer reading the article, and those who did read the article who are not engineers, and perhaps not readers of electrical journals, might not be enlightened by your correspondent's criticism.

It would be more satisfactory if mistakes in articles of this nature were politely pointed out and the intent of such articles were taken instead of the strict letter in all cases. J. E. STEWART,

Ass. M. Inst. C. E., M. Inst. E. E.

New York, July 31.

[If it were possible to make all the joints in a pipe line electrically perfect then there would, of course, be no corrosion due to the current passing across these points. But this would only partially overcome the trouble, as it would still be necessary to bond the pipe line to the rail at many points to properly conduct away the cross-currents which would flow between the two.

The question "When was it discovered that electricity is destructive of a good conductor?" has been unfortunately worded. Electrolytic action does not take place because the circuit is a bad conductor or a good conductor, but because it is a mixed conductor. That is to say, the current must pass from the metal into an electrolyte before electrolysis will take place.—ED.]

Fire Hazard of Kerosene.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your editorial of August 9 on "Electrical Fire Hazards" you cite as an example the case of a paper manufacturer who was forbidden to replace his gas jets with electric lights. It reminds me of a case that came under my own observation about three years ago in Mississippi. Looking over a large cotton mill in company with the owner I observed with surprise that a building filled with cotton products was lighted with several hundred *kerosene lamps*.

"Is this building insured?" I asked.

"Oh, yes; and well insured, too."

"Don't they make you pay a high rate for those kerosene lamps?"

"Well, the rates are pretty high and I thought to obtain a reduction by putting in a dynamo, but they told me they wouldn't reduce my rate any so I didn't change.

"Some day," he continued, "if this night work keeps up I shall probably put in a dynamo as a matter of economy, but the insurance men will not help me any."

Just think of it!

A. E. DOBBS.

New York, August 9.

Large Electrical Transmission.

It is not generally known that the biggest electrical power transmission works in the British Empire have just been opened in southern India. The generation station is constructed just below the Cauvery Falls, which are on the borders of the Mysore State, and one of the great sights of the country. They are situated in wild country, thirty miles from a railway. All the heavy machinery had to be conveyed over this distance by road, bullocks hauling, elephants pushing behind. The electrical power is conveyed across the jungles for a distance of over ninety miles to the Kolar Goldfield, where all the mines will henceforth be entirely worked by it. A feature of peculiar interest in connection with these great works at the Cauvery Falls is that they were carried out under the supervision of a Canadian, Captain Joly de Lotbiniere, R. E. But it is very gratifying to learn that the United States supplied practically all the machinery. Captain de Lotbiniere had great difficulty at the outset in overcoming the Hindu superstition that the goddess of the sacred river would destroy all who meddled with the stream. This superstition found corroboration in the native mind from a severe outbreak of cholera and heavy mortality from malaria which marked the commencement of the operations. However, tact and common sense were eventually too strong for superstition.

ELECTRIC LIGHT IN THE HOME OF THE PILGRIMS.

BY ALTON D. ADAMS.

Plymouth Rock, on which the original American expansionists first landed, lies a few rods from the lighting station in the home of the Mayflower passengers. Though Plymouth had an early start, the white population has never increased much faster than the Indians were killed off, and had reached only 11,547 in 1900.

Nevertheless, Plymouth is a fairly good place to sell electric light, and the local plant is on a paying basis, the operating expenses having been exceeded by the income to the extent of thirty per cent. in the fiscal year of 1901. The electric light station is located close to the water front, and its supplies of coal all come in barges from the Delaware capes. Feed water for the station boilers is taken from the town mains, and condensing water is furnished by a small pond.

The boiler plant contains two water-tube units of 200 horse-power each, and one fire-tube of 125 horse-power, all operated at 125 pounds gauge pressure.

One tandem-compound of 250 horse-power and two cross-compounds of 125 and 225 horse-power, respectively, make up the engine equipment. All three engines are run condensing constantly and are belted to their respective generators.

Direct current at 500 volts for motor circuits is developed by one dynamo of 150 kilowatts and two of 90 kilowatts each. One constant-current dynamo of 2,500 volts and 6.5 amperes is devoted exclusively to incandescent street lamps. All other lighting is done from a single-phase, 60-cycle, 2,200-volt alternator of 90 kilowatts capacity, and a similar machine of 120 kilowatts, General Electric make, is just being added.

Transformers connected to the system number 71 and are of the following sizes:

39 of 600 watts.	2 of 4,000 watts.
13 of 1,000 watts.	4 of 5,000 watts.
5 of 1,500 watts.	2 of 7,500 watts.
6 of 2,500 watts.	

All these transformers operate at 2,200 to 100 volts, 60-cycle, single-phase.

About 6,000 commercial incandescent lamps are connected to the alternating lines, also 19 enclosed arcs and 274 series incandescent street lamps of 75 candle-power each. Seven of the enclosed arcs and the incandescent street lamps are operated on a circuit controlled by a Manhattan regulator.

This little system is removed from the commonplace by the importance of its motor load. The motors are all of the direct-current, 500-volt type, and are located within a radius of one-half mile from the generating stations. Their capacities follow:

Horse-Power.	No.	Horse-Power.	No.
75	1	15	2
45	1	10	4
30	3	20 in numerous smaller motors.	
20	4		

The aggregate capacity of these motors is 340 horse-power, or about that of the entire connected load of lamps, if the draft of motors on the line, when working at full load, is taken at 340 kilowatts.

A large part of the power for the manufacturing industries of Plymouth is supplied by these motors. In the list of works operated by them are a woolen mill, zinc rolling mill, stove foundry and a mill making tacks, rivets and wire nails.

One effect of this exceptional motor capacity is an unusually large day load, another is an approximately uniform coal consumption throughout the year, and a third is the sale of a greater number of kilowatt-hours for power than for lighting. The effect on coal consumption is evident from the following figures:

1901.	Pounds Coal.	1902.	Pounds Coal.
July	315,740	January	392,405
August	312,285	February	346,440
September	306,260	March	340,832
October	350,117	April	307,655
November	379,380	May	322,805
December	388,753	June	308,540

In June, the weight of coal burned was 80 per cent of the like weight in the previous December, but the kilowatts supplied to electric lamps were 61 per cent greater during December, 1901, than in June, 1902.

The energy output of this system is metered at the station separately for the power and the lighting loads, so that it is possible to state the ratio of both power and lighting in the total kilowatt-hours delivered. For the twelve months, ending June 30, 1902, the percentages of total energy delivered to power and lighting circuits are as follows:

1901.	Percentage in Lighting.	Percentage in Power.
July	32	68
August	38	62
September	33	67
October	40	60
November	48	52
December	51	49
1902.		
January	39	61
February	46	54
March	51	49
April	46	54
May	47	53
June	40	60

For power, the largest percentage was 68 in July, 1901, but it stood at 61 in January, 1902, and was above 50 for ten months of the year. Lighting took its largest percentage of energy, 51, in December, and the following March. Variations in the power and lighting loads are due, in part, to the fact that some of the large users of power did not operate their plants continuously.

Taking the total number of kilowatt-hours delivered in July, 1901, at 100 per cent, the percentages in the following months are given below:

1901.	Energy Percentage to July.	1902.	Energy Percentage to July.
July	100	January	133
August	111	February	110
September	121	March	98
October	132	April	89
November	119	May	96
December	129	June	101

The largest percentage of energy delivery in any month, to that of July, 1901, was 133 in January, 1902, and in this month power lines took 61 per cent of the total output. October had the next largest percentage of the July figures, and in October the percentage of total energy going to power was 60. In December, the month of heaviest lighting, the percentage of total load to that of July was only 129. These figures illustrate, in a striking way, the ability of a relatively large motor load to keep up the energy output during the months when lighting makes its minimum demands.

At Plymouth, the problem of a paying system has been solved by adding power for the main town industries to the lighting load.

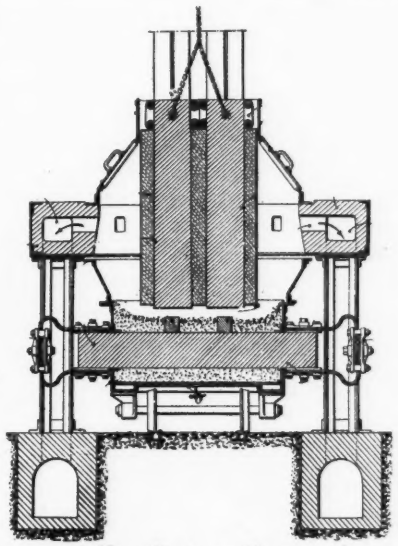
Bequests of Cyrus O. Baker.

The ELECTRICAL REVIEW announced two weeks ago the death of Mr. Cyrus O. Baker, a member of the New York Stock Exchange and an uncle of Mr. Cyrus O. Baker, Jr., the well-known platinum importer and refiner of New York and Newark. Mr. Baker left a fortune estimated at about $1,000,000, of which one-fourth was donated to friends and charities. Mr. Cyrus O. Baker, Jr., who is one of the executors of the estate, is also one of the residuary heirs to the estate, which consists of a large amount of valuable stocks and bonds, as well as considerable real estate and a very fine collection of pictures and curios.

The deceased was a brother of Mr. Daniel W. Baker, the first comptroller of Newark, and who was the pioneer refiner of platinum in the United States. Upon his death, about fifteen years ago, his son, Mr. Cyrus O. Baker, Jr., took charge of the platinum business and is the leading manufacturer and importer in this important industry in the United States. He is known among his friends in this country and abroad as the "platinum king." His brother, Mr. C. W. Baker, is associated with him.

Electrical Patents

Mr. Albert Simon, residing in Bordeaux, France, has devised a novel method of manufacturing iron, manganese and alloys of these metals by the aid of electricity, which has for its principal object a new process intended to render practicable the use of electric furnaces for obtaining the said products on a commercial scale. Attempts heretofore made to obtain such products in the electric furnace by reduction of the ores in the presence of carbon have not proved satisfactory, owing principally to the considerable loss of metal, owing to the readiness of the manganese to volatilize. This invention is based on the practical carrying into effect of the following observations: The lower oxides of manganese are soluble in fused fluoride of calcium. This solution can be used as the electrolyte, and it will yield metallic manganese at the cathodes under the action of a continuous electric current suitable to produce simultaneously the electrolytic decomposition and thermic action necessary for melting the mixture and keeping it in a sufficiently fluid condition. If the composition of the electrolyte be such that its point of fusion be not sensibly greater than that of the manganese (1,300 degrees to 1,400 degrees centigrade), and if this composition be kept about constant by regulated additions of oxide of manganese, the formation of the metallic bath will be continuous and the temperature moderate enough to enable the metal to be drawn off, while avoiding volatilization and the losses it entails. By the employment of the method set forth hereinafter, the reduction of the silicates contained in the ore, the same retains only a small quantity of silicon, and it will be evident that the silicon which results from the reduction of the silicates by the action of the electric current combines with the fluorine to form a gaseous fluoride. It is well known that the affinity or tendency of silicon combining with fluorine is very high. It will, then, be readily understood that the silicon which has been, so to say, absorbed by the fluorine will be set free, and, as before stated, the metal only retains a small quantity of the silicon. According to the invention, the electrolytic treatment can be employed alone or combined with the reduction by carbon. In the first case, say, when the electrolytic method is alone resorted to, the normal voltage varies from seven to eight volts for a current intensity of five to six amperes per square centimetre. The silicon reduced under the action of the current combines with the free fluorine to form a gaseous fluorine, which is set free, so that the metal only retains but small quantities of silicon. When the electrolytic treatment is combined with the reduction by the carbon, the silicon reduced, owing to the presence of the carbon in the bath, combines, as aforesaid, with the free fluorine to form a gaseous fluoride, which is set free, so that the metal only retains a small quantity of silicon. In this case of simultaneous employment of electrolysis and reduction by carbon, the normal voltage may be greatly increased, even to as high as eighteen or twenty volts. For the practical carrying out of the process an electric furnace is used, which is also the invention of Mr. Simon, and for which he is now obtaining a patent. This furnace consists essentially of a



A New Electric Furnace.

crucible or hearth, of a fireproof material of any suitable composition, mounted on a carriage and provided with raised sides. The cathode is formed of horizontal carbons arranged on the base of the hearth or crucible, the casing of which they traverse, and they are connected to the main circuit by means of flexible connections pressed against the carbons by plates. These carbons are embedded in a layer of crushed ferromanganese, the upper level of which rises about to three-fourths of the height of the casing. The purpose of this layer of crushed ferromanganese is to form a conductive mass with the bath of molten metal, as will be more clearly explained below. The upper electrode or anode is formed of four (or more) electric carbons, which are of dimensions proportionate to the power of the furnace, and which can be moved vertically by means of levers or the like. The carbons which form the upper electrode are enclosed in a casing or envelope of crushed slag, compressed with tar and resin. The manganese contained in this slag is monoxide, so that it can not promote the oxidation of the carbons. The form of this electrode is that of a rectangular prism sliding in a frame, provided on its four sides with charging-openings. The raised sides carry brackets at their upper ends placed under the brickwork, so as to securely close the interior of the furnace. A channel is provided in the brickwork, the said channel communicating by means of openings with the interior of the furnace and also with a dust chamber, into which the gases arising from the reduction process pass, together with the metallic dust and vapors. Two small blocks of carbon are arranged on the horizontal carbons, and extend just above the top of the layer of crushed ferromanganese, and serve to prime the furnace, for without these the current could not pass at a low temperature through the said layer of crushed ferromanganese, which then offers too considerable resistance. The operation is as follows: After the upper electrodes have been placed in contact with the carbon blocks, a mixture of fluor spa and carbon is gradually introduced through the openings, the constituents being in proportions suited to the voltage at which the furnace is working. The strength or intensity of the electric current in the said carbon blocks being very high, by reason of their reduced section, a very high temperature is developed around the said carbon blocks, and thus rapidly melts the mixture which has been fed into the furnace, and thus a bath is formed which gradually penetrates the resisting layer, which becomes more conductive. A temperature is thus gradually produced which finally reaches a normal and invariable degree corresponding to the minimum of volatilization of the metal, if the proper strength or intensity of electric current can be provided. A current, for example, of, say, forty to fifty watts per square centimetre of the sectional area of the upper electrode enables this result to be obtained. As the work of the furnace proceeds the metal accumulates on the hearth, where it remains in a fluid condition, by reason of the superficial resistance of the layer and its low thermic conductibility. When the bath of metal has reached the desired height it is drawn off in the usual manner. The present method also allows the obtainment of rich ferromanganese or other alloys of metals. For this purpose there is only to be introduced into the fuel mixture a suitable proportion of an oxide of the metal which is to enter into the composition of the alloy.

News from Great Britain.

(By Our Special Correspondent.)

IN consequence of the coronation and its attendant festivities, none of which, after all, happened, many events in the engineering world, usually held somewhat earlier in the year, were put off until a later period owing to the small amount of interest. The Incorporated Municipal Electrical Association is a body formed in 1896 for the mutual edification of electrical engineers in the employ of municipalities. During the past twelve months a good deal of energy has been introduced into the administration with the result that a splendid convention has been held.

Mr. E. T. Ruthoen-Murray, of the Wellesden Urban District Council (London), drew a deal of attention to himself by a paper strongly advocating double-current generators, a subject which has, until now, been but little discussed here, although as one speaker (Mr. Scott, of the Westinghouse company, Pittsburg) said in the discussion, they are used in America to a somewhat considerable extent. Mr. Murray is at present designing a three-wire system at Wellesden in connection with which he will use two of these double-current machines, and, furthermore, says he is going to have a switchboard there which will be as simple as any two-wire board he knows of.

Another very controversial subject was that of the correct type of steam engine for large power stations. Two authors discoursed upon this theme, one advocating slow-speed horizontal engines and the other steam turbines. The feelings of the meeting undoubtedly went out to the latter, while a few, more sanguine than the rest, are apparently looking forward to the turbine, although they all admit they do not know where to start. Mr. Snell, of Sunderland, got harshly criticised in advocating the two-wire system of distribution against what is now the universal practice here, *viz.*, the three-wire, and it is to be feared that his arguments and deductions have made but little impression. At the same time it must be confessed that he was, to a certain extent, misunderstood. He did not suggest that all existing three-wire networks should be abolished, but put it forward that the two-wire system for future extensions would be found advisable. Next year's conference is to be held in Sunderland, but it is a noteworthy fact, in connection with this association, that its best meetings are those held in London.

Another function held at this period was the twelfth International Tramways Congress, albeit the first held in London. The intention to hold this congress in London was directly responsible for the holding of a second tramways and light railways exhibition contemporaneously, but whereas the latter was purely electrical, the former, quite frequently, during the week the meetings were held, discussed subjects which were distinctly stated to be non-electrical. Another feature, which tended to make the proceedings drag somewhat, was the necessity for both papers and discussions to be given in the English, German and French languages. One of the most important papers was by Dr. G. Rasch, of the Polytechnic School, Aix la Chapelle, on "Proposed Basis for Estimating the Power of Motors." In this he supported the standardization regulation framed by the German Association of Electrical Engineers, but at the same time did not consider they were sufficiently detailed at present to be truly applicable to motors for electric traction purposes. In the discussion which went to no great length, a German speaker wished for the adoption of American methods as regards testing, etc. A peculiarity about all the papers was that they were really a collection of expressions of opinion of managers of various tramway undertakings on the Continent on the different subjects dealt with, the author's own ideas being somewhat obscure in a great many instances. However, every one of the foreign delegates at the finish appeared immensely pleased with their reception, and certainly no one could find fault with the social side of the programme.

As far as the exhibition went, if it did nothing else, it showed an astonishing advance since the previous one was held two years ago. Then we were told that the London County Council were thinking of electric traction for London; now we see one of the identical cars which will be employed on the South London conduit system. An exhibition of this character demonstrates far more than one, say like Glasgow, where all the exhibits of one nature are not necessarily kept near enough together. Looking round the Agricultural Hall any one with an engineering mind must ask himself the question as to why there is any necessity at all to go anywhere out of the country for any part of the equipment of an electric tramway. The answer may at once be put "what about cost," but this seems to compare well, and it is to be hoped that this exhibition which only lasted twelve days and ought obviously to have lasted much longer, will go a long way toward emphasizing home manufactures in a department which, hitherto, has been deemed to be somewhat beyond us. Although dubbed "international," it was remarkable how few foreign firms were represented at the exhibition.

Manganese.

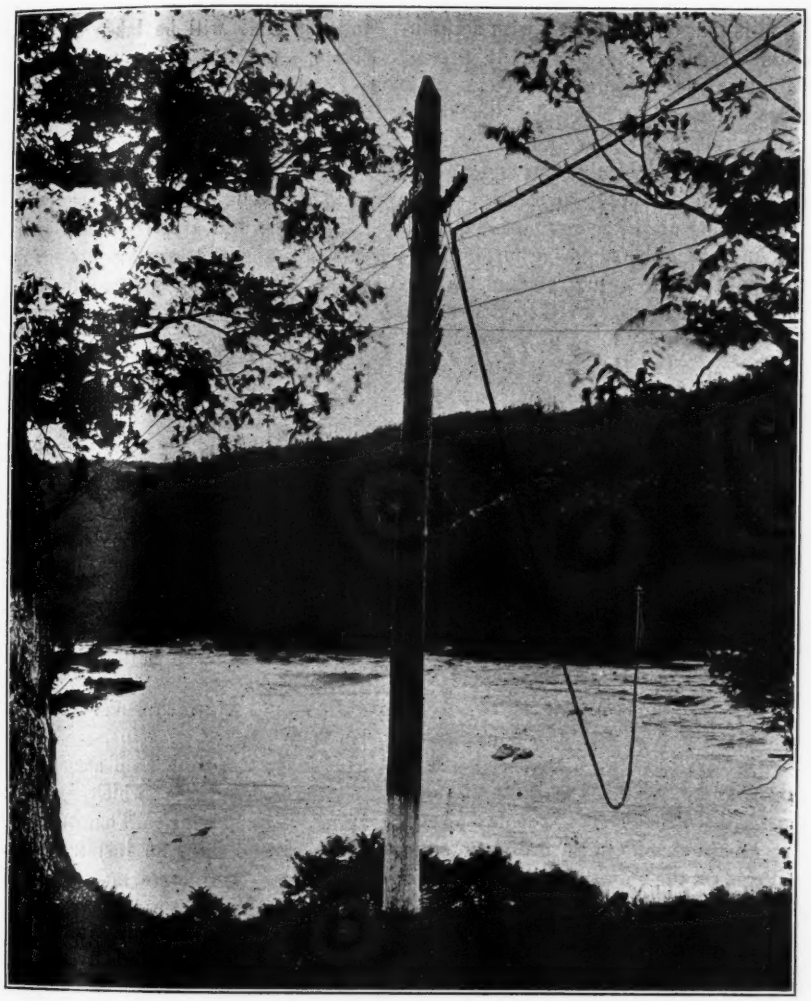
The total production of maganese ores in the United States during the year 1901 amounted to 11,995 long tons, valued at $116,722, as compared with 11,711 long tons, valued at $100,289, in 1900. The increase of the production of 1901 was only 224 tons, or about two per cent, but the average value per ton increased from $8.52 in 1900 to $9.73 in 1901, or $1.21 per ton.

In 1901 eight states contributed to the total, Alabama, Missouri and Utah being added to the 1900 list. Montana, a former producer, reported no ore mined. As in 1900, Virginia heads the list of production, Georgia being second and Utah ranking third; the combined product of which three states amounted to 10,849 tons, or ninety per cent of the total for the United States. At no time since 1891 has the annual production of manganese ores exceeded 16,000 long tons, which suggests that the domestic manganese industry has not developed into one of importance as far as quantity is concerned. The bulk of the supply still comes from foreign countries.

The amount of manganese ores imported in the United States during the year 1901 was 165,722 long tons, valued at $1,486,573, or $8.97 per ton, as compared with imports of 256,252 long tons, valued at $2,042,361, or $7.97 per ton, in 1900. The United States is the largest producer of steel in the world, and in the production of this steel a large amount of ferro-manganese and spiegeleisen is used. In 1901 the foreign ferro and spiegel were attractively low in price, so that a number of the larger companies preferred to import such manganese metal as might be required rather than to man-

ufacture it. This will account for the falling off in imports of manganese ores in 1901.

The principal shippers to the United States in 1901 were Brazil, Russia, Cuba, Turkey, Chile and India, in the order named. The importation by customs districts shows that over half of the total foreign manganese ore was received at the port of Baltimore and about one-seventh at Philadelphia. The average domestic production for thirteen years was 13,949 long tons, valued at $125,773, and the average imports in the same period amounted annually to 92,413 long tons, valued at $853,627. Manganese ore to the amount of 21,627 long tons was imported in the United States from Cuba in 1901, and it is probable that Cuba will continue to be an important source of supply of manganese ores of the United States. The Russian Empire is the largest contributor of manganese ores, nearly all the world's output being credited to that country. The greatest portion of this ore comes from the Caucasus district, followed in order by South Russia and the Ural districts. The imports in the United States from Russia in 1901 amounted to 32,600 long tons. According to the latest obtainable figures, the production of manganese ore for 1901 may be estimated for the most important producing countries as follows: Russia, 646,582 long tons; India, 130,670 long tons; Brazil, 95,710 long tons; Spain, 90,224 long tons; Germany, 58,269 long tons; Turkey, 38,100 long tons; Chile, 31,477 long tons, and Cuba, 25,183 long tons.



TELEPHONE CABLE SPAN OF 3,200 FEET OVER THE SUSQUEHANNA RIVER.

The Longest Cable Span.

Mr. H. C. Young, president and general manager of the Columbia Telephone Company, at Columbia, Pa., has swung across the Susquehanna River what he believes is the longest aerial cable span in the world, where, owing to its swift current, rocky bottom and ice gorges, the laying of a submarine cable is impossible.

The span connects the telephone system of Lancaster and York counties, and crosses from what is locally known as Chickie's Rock to "The Point," an air-line distance of 3,200 feet. Wires of steel, hard-drawn copper and aluminum had previously been swung across the river at this point, but they all went down during the sleet-storm of last winter, while the suspension cable, which had been strung across the river to support them, remained. Under these circumstances something had to be done and done quickly, and a rubber-covered cable consisting of ten pairs of No. 19 B. & S. conductors, weighing, according to the manufacturer's list, about 880 pounds per 1,000 feet, was fastened to the suspension wire that remained. The suspension or messenger wire is a special steel composed of seven strands of No. 12 B. W. G. ($\frac{5}{16}$ inch in diameter), weighing twenty-one pounds per 100 feet, which has a guaranteed strength of 25,000 pounds. This, with the span wire, weighs 1.09 pounds per foot, or a total of about 3,500 pounds, allowing fourteen feet extra for the dip of the span.

The poles are not on the same level, one being 270 feet and the other 100 feet above the surface of the river, which makes a difference between the elevation of the two sides of 170 feet. The lowest dip of the wire is thus not at the centre of the span, but at a point nearly two-thirds of the way across (100:270::1185:2115), where the span is about thirty-five feet above the surface of the river, which equals a drop of 122 feet below that of a straight line between the poles. Great as this drop is, it only equals about four per cent of the total length of the span. The strain on the messenger wire, using a table of constants given by Roebling, is 1016 by 1.09 = 10,917 pounds, or would be if the supports were both of the same height. As there is a difference of 170 feet in elevation, the strain on the higher pole would be somewhat heavier, and that on the shorter pole somewhat less, there probably being a difference of 350 pounds between the two.

In order to secure a firm support, the poles supporting this strand are of heavy chestnut, twelve inches in diameter at the top, and the anchorages are connected to two poles on either side.

The weight of the cable will undoubtedly steady the motion caused by the wind and prevent the "whipping" action which sometimes occurs with single wires.

Whether it will stand the sleet-storms of the coming winter remains to be seen, and we shall await information on this point with a great deal of interest.

Electrical Notes from Europe.

(By Our Special Correspondent.)

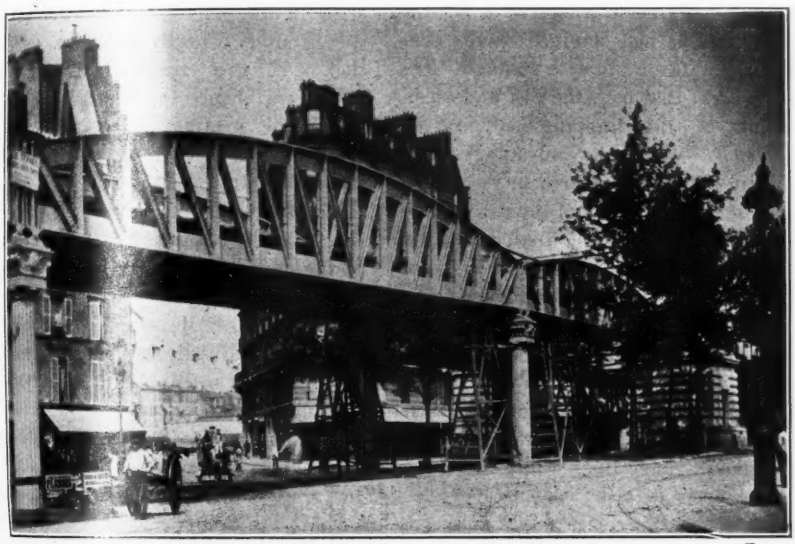
AN ELECTROLYTIC product which may receive considerable application has been discovered by Dr. George F. Jaubert, an eminent scientist of Paris. When the metals sodium or potassium are submitted to the proper treatment, they are capable of taking up a considerable quantity of oxygen, and these higher oxides have the valuable property of decomposing when placed in water, and giving off pure oxygen in quantities varying from 150 to 225 litres per kilogramme of material. This new product, called "oxylithe," is now being manufactured on a commercial scale by the Société d'Electrochimie, which has lately installed a large electrolytic plant in the southeastern part of France, operated by a fall of 500 horsepower. The action of oxylithe is quite analogous to that of carbide of calcium. In practice, this body, which is white in color, is pulverized and made up into blocks of four or five cubic inches capacity or into small, round tablets about half an inch in diameter. These are used in different forms of gas generator, in which they are put in contact with water. In this way it is possible to procure a supply of oxygen in an easy and simple manner, and besides the product is cheap, owing to its electrolytic method of manufacture. The process has many advantages over the use of compressed oxygen, as the gas is chemically pure; then the weight to be transported is very much less. The product of the reaction, which is a very pure solution of caustic soda, may be utilized, thus diminishing the expense. One of the most striking applications of this method is that of renewing the air in a confined space by giving it a fresh supply of oxygen, and thus with a certain quantity of oxylithe the same air can be used over again for a considerable period. This finds a practical application in the case of diving suits, and the Minister of Marine has had some experiments of this kind carried out. The helmets of the diving suits have been fitted with a small oxygen generator, and it was found that a quantity of the oxylithe equal to 100 or 150 grammes was sufficient to provide for the respiration of a person during one hour. The government is now carrying on experiments for using the process in submarine boats, where it will be of great value, as the quantity of oxygen needed for an entire crew of ten men for an hour can be given by two or three pounds of the substance, and therefore the space it would occupy is very small. In this way the boat may remain under water for a long period, and its range of action will be greatly increased. Perhaps the most novel application is that of doing away with accumulators on submarine boats. At present the submarines are run by batteries when under water and by a petrol motor at the surface. The inventor finds that the petrol motor may be also run under water by renewing its supply of oxygen. The exhaust pipe of the motor passes into an oxygen generator, which restores to the burned gases the proper amount of oxygen, and the renewed air then passes into the motor cylinder to be used over again. The arrangement forms a closed cycle which is independent of the outer air. The experiments which have been carried on at Paris have shown that a motor may be operated quite successfully by this method.

American automobiles will have an opportunity to enter the international concourse of automobiles, which has been organized by the Automobile Club of France. This concourse is designed to bring out the best types of vehicle for city as well as for suburban use, and these two classes will be kept distinct. The tests are to be held in Paris from October 23 to 29, next. There are three main points to be considered: (1) The cost per day of running an automobile in the ordinary service in Paris or the suburbs, the trial trip to cover thirty-six miles in all and upon various grades. (2) As regards the comfort and easy operation of the vehicle. (3) The frequency of renewing combustible, batteries, etc., also the extent and facility of repairs. The concourse admits all types of automobiles, and these are divided into two main sections, each of which includes several classes. The first section, for city service, has six classes of vehicles, ranging from two or four-place cabs up to delivery wagons of 660 pounds load, while the second section, for suburban service, comprises omnibuses of ten places, delivery wagons taking three-quarters of a ton load and the heavy hauling wagons. The vehicles may be entered for the concourse up to October 15, inclusive, and three days before the test each constructor is to furnish a complete description and give the data prescribed in the rules. The tests will cover a period of six days, and for each section there will be laid out two different routes, starting from the Automobile Club. The suburban vehicles will go as far as Versailles. Their general performance *en route* will be noted by an expert who will accompany each vehicle, and the time will be taken at different points, especially in mounting grades.

For the electromobiles the charging of the accumulators will be carried out under the supervision of inspectors together with the competitor's representative; the charging current will be taken from the city mains, and a special form of meter will indicate in kilowatt-hours the quantity of electricity furnished to each vehicle. The executive commission appointed to oversee the tests will include the members of the technical commission of the club and twelve members, chosen half by the commission and half by the competitors. The detailed report which will be made out will contain some very interesting data; it is to be communicated to the Civil Engineers' Society, etc. The concourse will thus bring out some useful figures upon automobiles for city use, especially as regards the electromobiles, which do not often have an opportunity to go through an official test. The long-distance races, which have been of such profit to the petrol vehicle, are impracticable for the former on account of the length of the route, which is generally from 300 to 800 miles. That of the recent Paris-Vienna race, for instance, was 864 miles, and there were no electromobiles entered. However, a race is soon to be held in Belgium (on July 31) which is of exceptional interest, and it is probable that electromobiles will be entered. The race will be a somewhat unique event, as it is to be held upon a stretch of road which makes a closed circle in the Ardennes region, forming thus a vast "autodrome." The circuit is fifty-four miles long and is to be covered six times, making 324 miles in all. The road is exceptionally good, so that the event will probably bring out some of the best long-distance speed records that have been made heretofore. The best speed record so far has been made by M. Serpollet in a petrol automobile over the distance of one kilometre; this he covered at the rate of 72.5 miles an hour.

The Metropolitan Underground of Paris proved so successful that it was de-

cided to greatly extend the system, and two different branches are now in construction. The original Metropolitan runs directly across the city from east to west, and is, therefore, not of great convenience to persons living in the northern or southern parts of the city. One of the new branches follows along the exterior boulevards and makes a half-circle through the northern part of the city. It starts from the Place de l'Etoile and ends at the Place de la Nation. A third branch has also been begun which will make a similar half-circle on the opposite bank of the Seine, so that eventually the whole will form a kind of belt line, which will be bisected by the present Metropolitan. The north branch is now being completed, and it is possible that it will be opened



Overhead Structure of the Paris Metropolitan Railway.

at the end of the year. Its construction presented considerable difficulties, as it had to cross the lines of the north and the east railroads. The tracks of each system are laid in a wide cutting below the level of the streets, and the Metropolitan was obliged to cut across these at right angles. This made the problem somewhat complicated, and two solutions were proposed—either an underground tunnel below the railroads or a viaduct passing above them. The latter solution was found the most practicable, as it would be difficult to construct a tunnel at such a great depth, and besides the passengers would be obliged to mount and descend from one branch to the other. Accordingly the line, which is underground from the Place de l'Etoile to the Boulevard Barbes, mounts an easy grade to a viaduct of iron construction above the streets, which continues to the Rue de Meaux, where it descends again to the underground tunnel. The total length of the present line is 6.3 miles, and it will have twenty-three stations along the route. The construction of the underground has not given any particular difficulties. The shield system, which did not prove satisfactory in the former work, has now been abandoned. At the terminal stations considerable work had to be done, for at the Place de l'Etoile the new line passes under the old Metropolitan, and at the Avenue de Villiers a double station has been constructed, which will be also the terminus of the southern branch. The most important underground work has been done at the Place de la Nation terminus. The line forms a large circular loop, and a new station has been constructed beside that of the old Metropolitan; the two stations will communicate by four openings in the masonry. During the work the tunnels are lighted electrically and electric locomotives are used to haul out the excavating wagons.

The overhead part of the line extends over 1.2 miles, and is formed by a series of trusses placed on iron columns at a height of fifteen to twenty feet above the street level. This construction will be observed in the engraving. The ends of the trusses are supported on the columns by rollers which allow for the expansion and contraction. At the stations, of which there are several on the overhead part, the width is increased by two additional girders, which support the side platforms. The latter are 288 feet long, as the former length of 250 feet was insufficient to provide for the long trains which are now being used. Hydraulic riveting apparatus, electrically controlled, has been used in the work, and as many as 500 rivets are placed per day where only 160 could be put in by hand. The underground tunnel joins on to the viaduct by a cutting lined with masonry. This makes a depression along the middle of the street, which has been partly roofed over by metallic plates.

A rather novel method of train lighting has been devised for the Fayet-St. Gervais-Chamonix electric road. The electric equipment for the sixty-four locomotive cars of this road has been furnished by the Alioth Company, of Bale, which has also supplied the lighting and heating apparatus. In this system the incandescent lamps are supplied directly from the line current. They are mounted five in series, in three parallel circuits. The variation of voltage allowed at the terminals is thirty volts, or six volts per lamp, and the system had to be fed directly, but without using any accumulators. This rendered the problem somewhat difficult, as the line voltage fluctuates between 410 and 530 volts, while the normal tension (using eighty-five-volt lamps) is 5×85, or 425 volts. As the variation allowed is thirty volts, the total fluctuation of ninety volts can be taken care of by inserting three resistances successively of twenty ohms each, the current being 1.5 amperes per lamp. By inserting these resistances the voltage can be kept within the prescribed limits, and it was only necessary to design a relay which should throw them in automatically. The relay consists in principle of a coil turning in a magnetic field, somewhat in the form of a Deprez-D'Arsonval galvanometer, and is dead beat. It is placed in shunt on the line. When the voltage increases the movable part is displaced, and each move corresponds to a variation of voltage. The movable system carries three arms which pass over contacts and short-circuit successively the windings of three electromagnets, which act as relays; when the armatures of the latter are attracted they short-circuit the resistance coils, and when released the resistances are thrown into the lamp circuit. This apparatus, which has been constructed by Hartmann & Braun, has already been tested, and is said to give good results.

C. L. Durand.

Paris, July 28.

Sir John Aird announces that the last coping stone of the Nile Dam at Assouan was laid on July 30.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

The Correct Type of Engine for Large Generating Stations.

Mr. A. A. Day's opinion on the question of high *versus* low speed is that if one adopts the principle of high speed, it should be high speed, and not moderately high speed. With moderately high speed sets, the space required is comparable with that required for low speeds. If the high-speed principle is adopted, the idea of personal, human supervision of the working parts must be abandoned. If this is admissible, the higher the speeds the better the results in economy and as regards space and material. After considering the subject for all points, the author believes the low-speed type of engine should be the one adopted in future for large power plants. That it would be condensing goes without saying. The type considered most suitable is a horizontal low-speed compound or triple-expansion engine, with direct-coupled generator between the cranks, a type which has been very successful on the Continent. The following advantages of this type of engine are given: Economy; the horizontal type does away with the necessity for steam pipes in the engine room; the engine can be kept clean at a minimum of expense and trouble; repairs will be found to be small if the valve gear be of the Corliss tripped type; the engine can be easily got at for repairs, and the same applies to the dynamos. The dynamo being placed between the two cranks, the shaft is not in any way cut up. The bearings can be adjusted both vertically and horizontally. It is claimed for the high-speed engine that it reduces condensation of the cylinders. This is balanced in a low-speed engine by the better drainage secured, if it can be fitted with Corliss valves. While the wear and tear of pistons on the horizontal type of engine is greater than the vertical, this can be minimized by having tail rods with outside bearings. The question of the arrangement of cylinders and the possibility of adopting compound or triple-expansion engines is not discussed.—*The Electrician* (London), July 25.

Narrow Versus Ordinary Gauges.

This paper, by M. C. de Burlet, was read and discussed at the International Tramway Union's congress. The question taken up was not street tramways, but light railways, such as the network of lines under the author's control in Belgium, which have a total length of 1,240 miles. The great advantage of the narrow-gauge line is its low cost of construction, as compared with standard gauge, the objections urged against it being its limited transport capacity and the necessity for trans-shipping passengers and goods at the point of junction with the main lines. As to the limited capacity of a narrow-gauge line, he had obtained results comparing very favorably with standard lines, and thought that both the cost and inconvenience of trans-shipping had been exaggerated. While the advantages of a uniform gauge were many, in the case of many of their branch and interurban lines it was necessary that the first cost, as well as the working expenses, should be as low as possible. A table is given showing the approximate cost per kilometre of the construction of light railways on the Continent. From this it is seen that the cost of constructing narrow-gauge lines varies between one-half and two-thirds of that of standard-gauge lines, while the cost of maintenance is also considerably less. The author's experience was that the use of the narrow gauge enabled lines to be constructed and operated on a profitable basis, which otherwise would be commercially impracticable. In special cases, where the line is short and intended to serve principally for the transporting of goods from the point of junction to the main line, it would probably be well to adopt the standard gauge.—*Electrical Review* (London), July 21.

A New Brake Method for Determining the Efficiency of Electric Motors.

It is important that manufacturing companies be able to make accurate tests of their machines, either with the intention of guaranteeing their results or of improving the construction of the machines. The direct Prony brake method is not altogether reliable, since tests made under the same conditions of load and potential may differ by as much as five per cent in efficiency. Explanations for these variations are given as follows by Mr. Paul Jobst, and a method by which these errors can be eliminated is described. Errors are brought in from changes in the friction resistance of the brake, causing vibrations of the balance. An eddy-current brake may be used with better results. The determination of the speed is very difficult, since if readings are taken by one observer he must watch the time as well as the speed counter. If two persons are employed there is a chance for non-agreement between the readings. An error in speed readings produces an equal error in the determined efficiency as the speed enters directly into the calculation. If two persons are employed, there is a chance for non-agreement between the readings since it is impossible for them to read at exactly the same instant. The author recommends an electric speed counter in which the potential is proportional to the speed of the motor. This may be self-exciting, separably-exciting or have permanent magnet fields. Measurement of the energy input is easily accomplished with a suitable wattmeter. For simultaneous readings of the instrument in a brake test from four to six persons are necessary. This introduces a chance for error, since it is impossible for the observers to have the same personal equations, and therefore they do not read the instruments at the same time. For accurate results the following arrangement is recommended: A spring balance is used to measure the torque developed by the motor. Beside this is placed a shelf upon which are arranged meters for measuring the current, voltage and speed. Suitable arrangements are provided for keeping the brake arm horizontal, and a length of arm is adopted which simplifies the calculation. For making observations, the brake is adjusted in the desired reading, then a photograph is taken of the indications on the instruments. In this way twelve different readings may be taken in two minutes, giving instantaneous values independent of observation. This method is thought to be valuable in that it does away with all personal errors, saves a large amount of time and energy, and since the brake is in use for such a short time there is no need of cooling it.—*Electrotechnische Zeitschrift* (Berlin), July 17.

Standards for Electrical Apparatus.

The following are the standards for the testing of electrical machinery recommended by the Verband Deutscher Elektrotechniker.

All machines and transformers are rated by the power delivered. For continuous-current apparatus the capacity is to be given in kilowatts, and for alternating current, in kilowatts together with the power-factor.

Three classes of service are distinguished—intermittent, short time and continuous—and the normal capacity of apparatus is that which can be maintained for the time designated without exceeding the prescribed limits of temperature.

The rise of temperature is to be measured after one hour of uninterrupted operation in the "intermittent" class, and in the "short-time" class after the apparatus has been in uninterrupted operation for the time marked on the plate. In the "continuous" service class the rise of temperature of machines is to be measured after ten hours' operation, and of transformers after a constant temperature has been reached. Smaller machines, whose temperature will become constant in less than ten hours, may have the rise measured after a correspondingly shorter interval. When the temperature of the air is not higher than thirty-five degrees centigrade, the rise in temperature must not exceed the following figures:

(*a*) Insulated windings and collector rings with cotton insulation, 50 degrees centigrade; with paper insulation, 60 degrees centigrade; with mica and asbestos insulation, 80 degrees centigrade. A ten-degree higher rise is permissible for stationary coils.

(*b*) Commutators, 60 degrees centigrade.

(*c*) The iron of generators and motors in which windings are imbedded must not show a rise greater than that allowed for the respective classes of insulating material under (*a*).

Temperatures of certain parts are to be measured with thermometers, and of other parts by their increase in resistance. In the latter case the temperature coefficient of the resistance of copper is to be taken as 0.004, when not specially determined.

Generators, motors and converters must be able to stand an overload of twenty-five per cent for thirty minutes, and motors, converters and transformers an overload of forty per cent for three minutes without heating above the limits already designated.

The measurement of the resistance of insulation is not prescribed, but tests of its dielectric strength must be made at the place of manufacture, and, for large parts, also after erection. Tests are to last thirty minutes, and apparatus designed for voltages of 5,000 and under must stand twice the working pressure; apparatus for voltages between 5,000 and 10,000 must be tested with 5,000 volts above the working pressure, and apparatus for voltages above 10,000 must stand one and one-half times the working pressure.

The efficiency of an apparatus is the ratio of the power output to the power input, and can be determined, directly, by measuring the power, or, indirectly, by measuring the losses. The indirect methods are generally to be preferred. When the efficiency is designated, the method by which it is determined must also be given, and the following methods are prescribed: (1) The direct electric method; (2) the indirect electric method; (3) the direct brake method; (4) the indirect brake method; (5) the "no-load" method; (6) the auxiliary motor method; (7) the steam indicator method; (8) the "loss separation" method, where machines can be run only by the use of "foreign" bearings.

An appendix contains standards which are recommended, but which can not yet be insisted upon. The frequency recommended is either twenty-five or fifty. Voltages should correspond with the following tables:

CONTINUOUS CURRENT.

Motor.	Generator.
110 volts.	115 volts.
220 volts.	230 volts.
440 volts.	470 volts.
500 volts.	550 volts.

Motor or Primary Terminals of Transformers.	Generator or Secondary Terminals of Transformers.
110 volts.	115 volts.
220 volts.	230 volts.
500 volts.	525 volts.
1,000 volts.	1,050 volts.
2,000 volts.	2,100 volts.
3,000 volts.	3,150 volts.
5,000 volts.	5,250 volts.

—*Engineering Magazine* (New York), August.

Application of High Temperatures by the Electric Arc and Blow Pipe.

The production and application of processes enabling us to obtain economically high temperatures are becoming very important. Particularly is this the case in autogenous soldering where the metallic parts are joined together by fusion, no special soldering being used. Several applications of the electric arc and the oxyhydrogen blow pipe in this work are described by Mr. Paul Dupuy, and the advantages of the two briefly discussed. One interesting application of the electric arc for soldering is that for repairing evaporating kettles in caustic soda works. These kettles in time show corrosion of their partitions, due to electrolytic phenomena. The repairs have been made by means of a special rivet, but this simply served to aggravate the trouble. In applying the electric method the process is as follows: The opening is cleared out and filled up by a special rivet. It is then covered by a soft solder and a paste of borax. The positive pole of the generator is then connected to the kettle, and the negative pole, consisting of a copper rod held in special nippers, is applied, allowing 400 amperes at 125 volts to pass. Then a small piece of iron is placed upon the part and an arc formed. This fuses rapidly and fills up the opening, making a perfect joint. The electrodes employed are twenty-five centimetres in length and three in diameter. The current varies from 300 to 400 amperes, and a pressure of from forty-five to sixty-five volts. A relatively long time is necessary, because the work must be interrupted frequently, since the operators are strongly affected by the radiations from the intense violent white light. This radiation burns the skin and face and causes excessive nervousness of the workmen. It is possible to avoid burning by proper shields, but the nervous effect can not be easily overcome. The next method described is one in which the electricity is indirectly employed; that is to say, an oxyhydrogen blow pipe is used, the gases of which are prepared by electrolysis. The advantages of this method are given as follows: A possibility of regulating the temperature, changing the flame at will from oxidizing to a neutral or reducing one. The cost of the blow pipe is not large, and the apparatus itself is small. One disadvantage of the electric arc is that it causes a carbonation of the metal to be soldered, especially if the work is done on iron and steel. This disadvantage is not encountered in the use of the blow pipe, nor is the objectionable nervous affection caused. An application of the electric furnace to glass manufacture is described and the advantages are discussed.—*Revue Practique de Electricite* (Paris), July 20.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Electrically Driven Tools.

The individual driving of machine tools by electric motors is far superior to any method yet devised, and the advantages gained over ordinary belt-driven tools are many. The facility with which gear connections or direct driving can be adopted, and the advantages of cleanliness and compact arrangement are undisputed. While many forms of motors have been designed for the driving of machine tools, and have met with great success in this application, the excellent results obtained by building both the motor and tool in the same shop and combining both in one machine are self-evident. The machines shown in the accompanying illustrations are the result of a long experience with tools of this description. These are only a few instances of a long list of similar applications for every variety of service, but they will be of interest because of the peculiar conditions under which each operates.

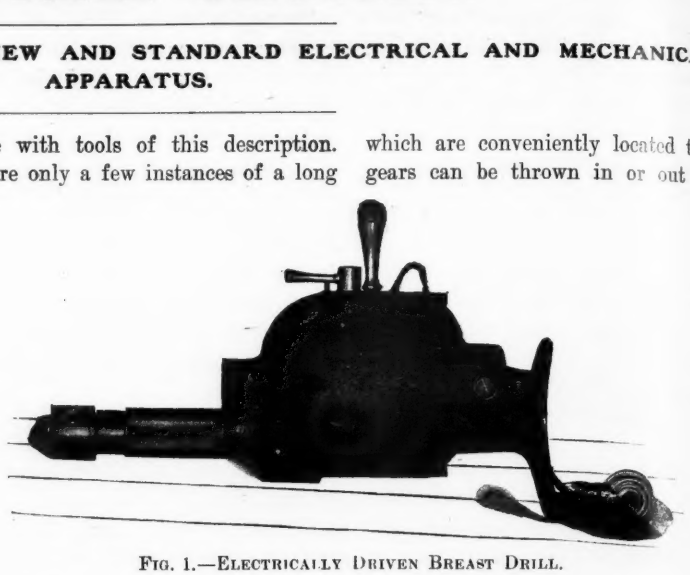


FIG. 1.—ELECTRICALLY DRIVEN BREAST DRILL.

In Fig. 1 is shown an electrically driven breast drill. This has been designed for drilling many small holes in large pieces. This will be found very effective for such work, and a great time-saver over the old hand drill. The drill is driven at a much higher speed than is possible by hand, and the operator can give his entire attention to guiding the drill, and can keep at it for a longer period, as his strength is conserved, and not exhausted by operating the crank.

FIG. 2.—ELECTRICALLY DRIVEN 22½-INCH DRILL.

Fig. 2 is an electrically driven twenty-two and one-half-inch drill. This drill has a driving motor and controller built into the column of the machine. It is geared direct to the spindle for the high speeds, and through a back gear for the slow speeds. The motor has nine speeds, which, in connection with the back gear, give eighteen speeds for the drill spindle in geometrical progression from 24 to 440. This has a friction back gear that may be thrown in or out without stopping. The power feed has three changes for each speed, and by cone pulleys which are conveniently located the back gears can be thrown in or out without stopping. The power feed is provided with an automatic stop.

Fig. 3 is an electrically driven water tool grinder. This has a driving motor and controller encased in the lower part of the housing, where it is completely protected from dirt and water. The frame is cast in one piece, and contains a seat for the wheel bearings, water reservoir and magnet frame of the motor. The bearings of the wheel have large wearing surface, are dust-proof and self-oiling. A drawer is arranged to catch all

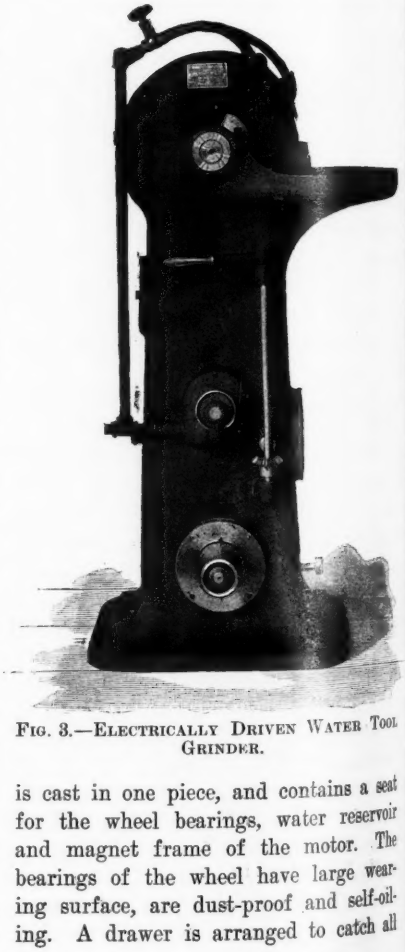


FIG. 3.—ELECTRICALLY DRIVEN WATER TOOL GRINDER.

sediment, which may easily be removed for cleaning. A small centrifugal pump, driven from a pulley on one end of the motor shaft, delivers a constant supply of water, and by means of adjustable nozzles can be directed where wanted or shut off altogether. The pump is so made that no grit can get into the bearings. The bowl is sufficiently large to catch all splashing water and return it to the reservoir. The motor is four-pole, with form-wound field and armature coils, slotted armature core, radial carbon brushes and self-oiling bearings. The machine is started and stopped by a handle shown on the side.

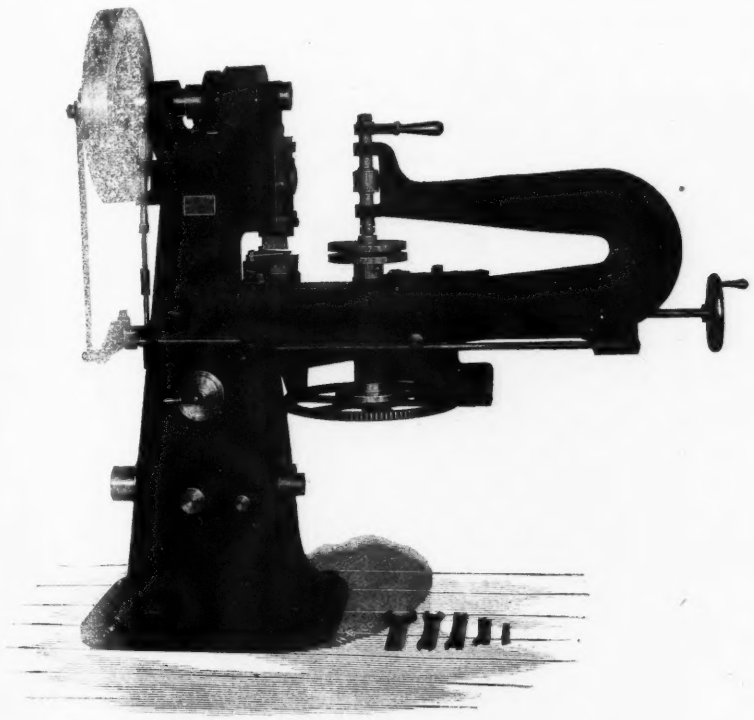


Fig. 4.—Electrically Driven Armature-Disc Notching Machine.

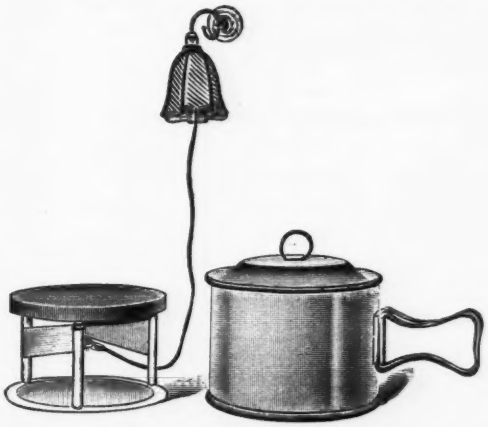
Fig. 4 is an electrically driven armature-disc notching machine. In this machine the motor is built into the frame and the frame forms a part of the magnetic circuit of the motor. The indexing mechanism is very simple, and not liable to get out of order. The index plates are held in place by a nut and taper dowel pin, and will always go back exactly to the same place, so that any discs punched at one time will match those punched at another time. The index plate is operated by means of a pawl driven from a slotted crank disc on the end of the main shaft, and can be quickly adjusted for different lengths of stroke. A locking pin is operated from a cam on the main shaft, which locks the index wheel in position at the moment the punch is cutting the notch, and ensures every notch being correctly indexed. An automatic stop is provided, which stops the machine when the disc is finished. One of the principal features of this machine is the convenient arrangement of the shafts that operate the indexing mechanism and automatic stop. These shafts are parallel with the ways on which the indexing head is carried, and in changing for a different diameter of disc the change can be very quickly made by loosening the clamping screws and moving the head to the desired position and retightening the screws. The disc-clamping device enables the work to be put in and taken out without loss of time, and the discs are held securely. The motor is made as simple and substantial as possible, so that it will not give trouble. This is a bipolar type with ironclad armature. The commutator is insulated throughout with mica, fitted with radial carbon brushes, form-wound field coils, steel pole-piece and self-oiling bearings.

These machines are made by James Clark, Jr., & Company, of Louisville, Ky. This company has made a specialty of designing machine tolls and equipping them with motors, both built in the same shop. The motors are located so as to be protected from injury and are out of the way. In every installation there is a great saving over the old style of shaft and pulley driving. These machines have met with a very popular demand and are being used very successfully over a wide range of severe service.

A Traveler's Electric Stove.

Probably one of the simplest apparatus adapted for electrical connection would be in the form of heating implements, and the demand for such an appliance is not only popular, but the condition under which a large proportion of the traveling public lives would seem to make it a necessity. In the accompanying illustration the outfit shown is claimed to meet a very present demand for an electric heater which is equally as useful at home as when traveling. The bottom is recessed so that the cup encloses the heater and locks this in place. The heater is oxidized steel, and the frame white enamel. It has six feet of conductor cord and a lamp socket plug with an adapter, so that it may be connected to either an Edison or a "T.-H." socket. An asbestos table pad permits its use on a polished table without injury from heat. The cup has a capacity for three half pints, is heavily tinned inside, and of polished nickel outside. All the parts pack within the cup, which is three and one-quarter by five inches, and weighs complete two and one-half pounds when packed. It is said that this heater is very useful for the preparation of hot water or for any purpose, and in an emergency can be used for making toast or even heating a small flat-iron.

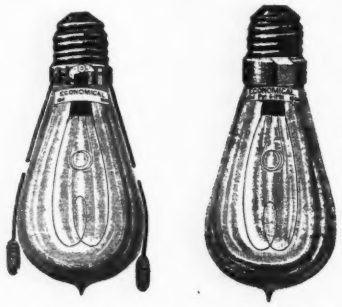
These electric stoves are furnished in voltages ranging from 110 volts up to 250 volts, and are manufactured by the Simplex Electric Heating Company, Boston, Mass.



A Traveler's Electric Stove.

A New Turndown Light.

The lamp shown in the accompanying illustration is screwed into the socket like an ordinary lamp, no change being necessary, the base being standard. When the current is on, the light can be changed without touching the bulb. Should the small light be wanted, by pulling the string with a tag marked "Dim," the desired light is obtained. For full light the string marked "Bright" is pulled, which gives a maximum illumination. The feature of this lamp is intended to be in its applicability to any style of fixture, no matter what position the fixture may be in, whether upright, downward or from the side, either open or enclosed shade, as the switch is so arranged that the string can be pulled from any angle and the string is reached no matter how high the fixture may be. The lamp must be screwed tightly into the socket for either light. This obviates danger of its working loose from the socket by the effect of vibration. These lamps are made by the



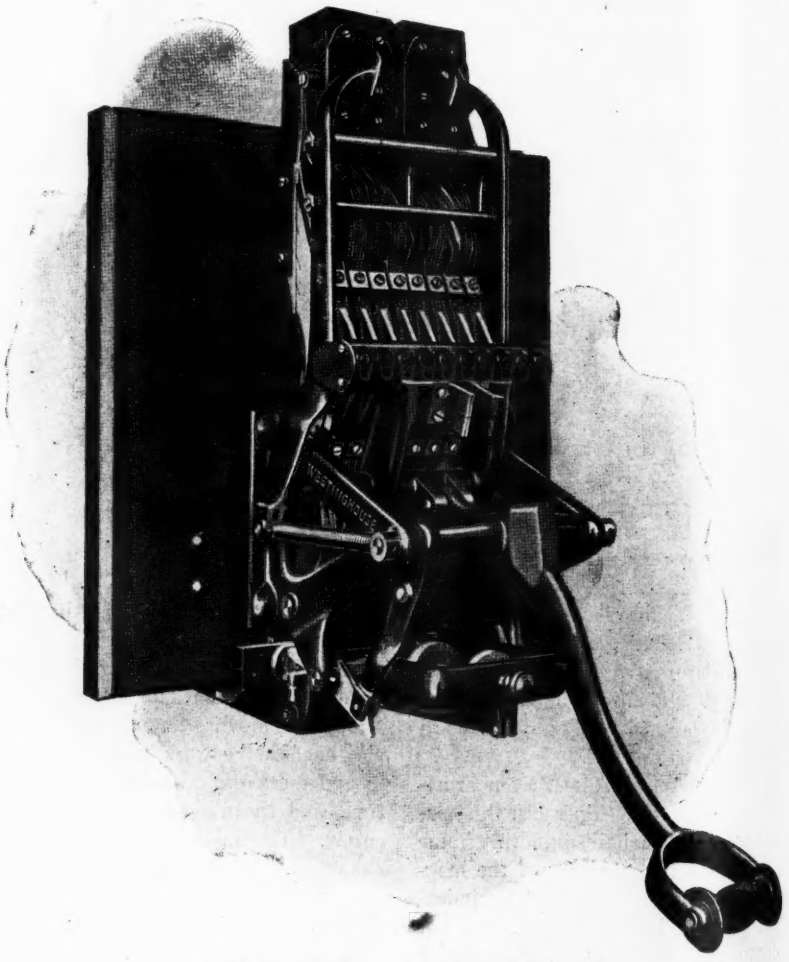
16-Candle-Power Turndown Lamp.

Economical Electric Lamp Company, 123 Liberty street, New York, and great care is taken in the testing of each lamp as to wattage, candle-power and voltage. They are made in eight and one candle-power, sixteen and one candle-power and sixteen and two candle-power, and in all voltages from 50 to 250.

Large Capacity Circuit-Breaker.

The use of very large direct-current generators for railway service and the necessity for securing uninterrupted operation have confronted electrical manufacturers with a difficult and serious problem in the design of circuit-breaking devices; as the requirements of such large units exceed all previous undertakings in the amount of power delivered to the system. To handle circuits of this nature, transmitting such large amounts of power, requires that the general design, both mechanical and electrical, of the circuit-breaking devices must be of the highest order to ensure the greatest degree of safety and reliability of operation.

For the direct-current generators recently constructed by the Westinghouse Electric and Manufacturing Company for the Boston Railway Company, it was necessary to build switchboard apparatus of unusual size, the most notable of which is an automatic circuit-breaker. In the accompanying illustration is shown the type of circuit-breaker supplied with the above-mentioned generators. The normal rating of the breakers being 8,000 amperes capacity, places it among the largest circuit-breakers yet manufactured. It should be especially noted that this piece of apparatus is an enlargement of the standard type "C" circuit-breaker, which has given excellent satisfaction under all conditions of service.



8,000-Ampere, Type "C" Circuit-Breaker.

The type "C" circuit-breaker is of the laminated brush type and is made in 1, 2, 3 and 4-pole combinations, each element of the set being provided with an automatic tripping coil which acts independently of the others or they may be made to operate simultaneous if desired. In general this breaker consists of an upper and lower contact block connected together by laminated copper brushes. Upon these brushes phosphor-bronze springs are placed and upon these are the carbon contacts or arcing points; the brushes are held in contact with the contact blocks by means of a toggle mechanism locked by a trigger attached to the scale beam. The circuit-breaker can be easily closed by hand and will open automatically throughout its entire range (the 8,000-ampere breaker has an adjustable range between the limits of 2,000 and 10,000 amperes). To avoid any possibility of arcing at the laminated copper brushes, woven copper cables are fastened from these brushes to the carbon arcing point. The automatic action is obtained in a very simple manner and without the use of coils by surrounding the lower contact block with a "U" shaped magnet of laminated iron and the magnetic circuit is completed by an armature of laminated iron attached to the scale beam.

In operation, the action of the circuit-breaker is as follows: The passage of the circuit through the lower stud brushes and upper stud energizes the "U" shaped magnet which attracts the armature. This

releases the trigger, unlocking the toggle joint, and copper spring brushes throw the breaker open. In breaking contact, the copper brushes leave the contact block first, aided by the pressure of the brushes which act with the releasing spring instead of against it, followed by the phosphor-bronze spring, then the carbon block or arcing point of the out-moving breaker armature separates from its carbon contacts and its circuit is broken. By this method the current is gradually shunted from the carrying brushes to the carbons, thus preventing any arcing from the metal parts of the breaker.

Storage Battery Installation.

That there is a growing demand for storage batteries for residential and isolated plants is very evident from a glance at the list of contracts secured by the leading battery makers. The accompanying illustrations are those of a typical storage battery installation. This plant is owned by the Hastings Sons Publishing Company, Lynn, Mass., which has recently erected a fine office building, five stories high.

The power equipment of the building includes the following machinery: Three motors, of one, two and five-horse-power capacity respectively, for the stereotype department; two motors, three and three and one-half horse-power, for the linotype department; a one-half-horse-power motor for the machine shop; a thirty-horse-power motor and a twenty-horse-power motor for the newspaper presses in the basement, these motors being arranged with countershafts, so that either one can be used on either of the presses. There are two elevators—one for passengers, rated at 1,000 pounds load, 200 feet per minute; the other a freight elevator, rated at 8,000 pounds, and thirty-five feet per minute, driven by a seven and one-half horse-power motor. Power is supplied by a steam plant located in the basement, consisting of two fifty-horse-power return tubular boilers and one thirty-five-kilowatt direct-connected generator. The building is wired for 520 lights; the lighting load and steady motor load during the day are not very heavy, averaging about seventy-five amperes, excepting when the press is in operation, between three and five P. M., when it averages over 200 amperes, running up to 425 amperes frequently, and 600 amperes occasionally, when the elevator and large press motors are accelerating at the same time. Under such trying conditions it would be utterly impossible to supply lights from the same machine as that supplying the power without unpleasant flickering, due to changes in speed of the engine, and on this account a battery of chloride accumulators

FIG. 1.—STORAGE BATTERY INSTALLATION IN THE HASTINGS SONS PUBLISHING COMPANY'S OFFICE BUILDING, LYNN, MASS.

FIG. 2.—THE SWITCHBOARD IN THE DYNAMO ROOM, HASTINGS SONS PUBLISHING COMPANY'S OFFICE BUILDING, LYNN, MASS.

(Fig. 1) was installed, and the power bus separated from the lighting bus, the two being connected only through a constant-current booster. All the unsteady power demand is taken from the bus-bars to which the battery is connected, and the constant-current booster transmits the average power required from the lighting bus-bars to these bus-bars, all the steady current demand being taken from the bus-bars, which are fed directly from the generator. Under the heaviest and most sudden loads the voltage variation on the lights does not exceed three per cent, and ordinarily is under two per cent.

The engine starts at 8.30 in the morning and operates until noontime, carrying whatever load is needed, and at the same time charging the battery. During the noon hour, from 12 to 1.30, the battery carries the entire load of the building, and no attendance is required. At 1.30 the engine is started again and operates until 6 P. M., when it is shut down and the battery carries the entire load of the building, amounting to about thirty amperes, up to one o'clock at night, after which time the load is light, consisting only of hall lights and such lights as the watchman uses on his rounds. During the morning run the battery is recharged. In the summer months the engine is only run about six hours per dav, and it has never been necessary to start up on Sunday.

The switchboard (Fig. 2) consists of three panels, with ammeters, voltmeter, recording wattmeter and all necessary instruments and switches for controlling, handling, indicating and recording the output. All circuits are arranged so that they may be connected either to the lighting bus or to the power bus, and an arrangement is provided so that connection can be made with the city mains, if desirable, through a special set of bus-bars, but this has never been done, as the plant is entirely self-contained, and no necessity has ever arisen for outside help, the storage battery providing all necessary reserve against temporary accident.

The booster is a motor-driven machine of about eight kilowatts capacity. The battery consists of fifty-eight elements, installed in glass jars, giving it a capacity of 200 amperes, and capable of being increased twenty per cent by the addition of plates. It is installed in an extremely small floor space, owing to the exigencies of the plant, being placed under the sidewalk in a room 6 by 20 by 17 high, lighted by a glazed pavement in the sidewalk. The battery is arranged in two rows, three tiers high, and, the light being from above, gives good results for inspection purposes. The room is ventilated by a twelve-inch by twelve-inch shaft, running to the top of the building. Between the battery room and the engine room is a tight partition, built of glass, providing plenty of light for the engine room. The cement floor is drained into a connection with the sewer, in case water or acid should be spilled.

The Electric Storage Battery Company, of Philadelphia, Pa., is the manufacturer of the "chloride accumulator" batteries used in this installation.

Automatic Car-Type Circuit-Breaker.

The protection of railway motor equipments by the use of a fuse has been satisfactory only to a limited degree, as this frequently fails to blow at the proper time, or to give the equipment the best protection under all conditions of service. The necessity of carrying extra fuses, as well as the inconvenience of stopping the car to replace a blow-out fuse, is more or less of an objection to this method, and many of the largest street railway companies have replaced the fuse block with the automatic car circuit-breaker. This practice offers better protection to the equip-

ment, as it reduces to a minimum the possibility of injury to the apparatus arising from the carelessness of the motorman in improperly cutting out resistance. The circuit-breaker will open automatically when the current reaches the value for which it is set.

Aside from the protective feature of a circuit-breaker the convenience in resetting it is obviously of great value. The motorman in throwing the handle of the breaker after the occurrence of a heavy overload or short-circuit is not required to leave his position at the controller to put the car in service. In most cases it is not necessary to stop the car, as the breaker can be reset while drifting.

The automatic car circuit-breaker shown in the accompanying illustration performs the function of the fuse block by opening an overload or short-circuit; it also replaces the platform or canopy switch, in that it provides a hand opening for the circuit. In construction the instrument is thoroughly fireproof, of the best material and workmanship throughout, and all parts are interchangeable. Its design prevents any arcing at the current-carrying contacts, as the arc is broken on extra contacts especially provided for the purpose and assisted by a powerful magnetic blowout which will open the severest short-circuit without damage. The breaker is calibrated and can be set to open at any current within the limit of its range. The automatic opening device ensures absolute certainty in opening when the current reaches the predetermined value.

This circuit-breaker is made by the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa.

Convention of Sales Managers.

During the week beginning July 28, the district managers and agents of the Fort Wayne Electric Works held a convention at the home office which was very interesting because of its business features, and also because of the social enjoyment of the occasion. Representatives from all the large cities in which the company has sales offices were present.

Mr. F. S. Hunting, general sales manager, made the evenings of the week especially interesting in a social way by a trolley and theatre party to Robinson Park, Wednesday evening and Friday evening. The week was fittingly ended by a banquet tendered by the Fort Wayne Electric Works to the district managers and sales agents at the Wayne Club at which were present Lieutenant-Governor Gilbert, H. C. Paul, president of the Fort Wayne Electric Works; Hon. R. S. Taylor and several local directors. Judge Taylor gave a very interesting early history of the business and the early struggles of the founders of the Fort Wayne Electric Works, and related how he and R. T. McDonald, when working together to gather evidence to defend an infringement suit brought against the infant concern for manufacturing an arc lamp, discovered Mr. J. J. Wood, then a young man.

The representatives present were: J. Allan Smith, Boston, Mass.; E. B. Goldsberry and C. A. Woolsey, Philadelphia, Pa.; A. E. Dresser, Syracuse, N. Y.; J. E. Hall, Pittsburg, Pa.; T. J. Ryan, Cincinnati, Ohio; T. W. Dixon, St. Louis, Mo.; A. H. Savage, St. Paul, Minn.; W. S. Goll, W. C. Knight, Frank McMaster, Chicago, Ill.; A. L. Searles, Grand Rapids, Mich.; J. C. Lott, New York, N. Y.; T. L. Sturgeon and Fred L. Reynolds, of the home office.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

EQUIPMENT PURCHASED HERE—The Northeastern Railway Company of England, several of whose officials were lately on an American inspection trip, has decided to utilize electric traction for the handling of traffic in the vicinity of Newcastle-on-Tyne. About thirty-seven miles of standard gauge road, mostly double track, will be converted. Some part, if not entirely all, the necessary equipment will, it is expected, be purchased in the United States.

MONSTER MOTORS—The two electric motors ordered by the Baltimore & Ohio Railroad Company from the General Electric Company are said to be the two largest electric motors in the world. Each machine will weigh 150 tons and be capable of drawing 1,500 tons of freight up the heavy grades of the belt line tunnel, which runs nearly two miles under the city. Passenger trains have been drawn through the tunnel by electricity since it was opened in 1895, but the motors now in use are not capable of pulling the heavy freight trains. The motors will be designed to haul twice the load the steam locomotives at present pull through the tunnel.

THE TELEPHONE SERVICE OF GERMANY—Under date of July 11, 1902, Consul-General Richard Guenther writes from Frankfort: The telephone service of Germany is carried on by the post office department. According to an official report, the cost of the entire plant, up to April 1, 1902, amounted to about $42,000,000. Up to April 1, 1901, the cost had been $36,600,000. At the beginning of the present year, 2,024 places had public telephone stations, with 322,281 miles of line. These stations averaged 2,205,966 conversations per day, or about 804,000,000 per year. The following cities have the greatest number of public telephone stations: Berlin 51,561, Hamburg 20,823, Frankfort 9,271, Dresden 8,914, Leipzig 8,725, Cologne 7,484. The total number of employés in this service is 8,189, of which Berlin has 1,712.

STREET RAILWAY EXPANSION—The Westchester (Pa.) Street Railway Company has been incorporated at $1,000,000 by a vote of the majority of the stockholders. The previous capital was $60,000. A reorganization and recapitalization was determined upon, in order that extensive improvements could be proceeded with. These extensions form a belt line from Westchester to Kennett, West Grove, Oxford, Parksburg, Coatesville, and *via* Downington, Westchester, connecting with the present line, the Westchester Street Railway. It is probable that the name of the corporation will be changed later to the Brandywine Traction Company. A portion of the extension to Downington is now more than two-thirds completed and the extensions to Kennett and Coatesville will be put in course of construction very shortly. This is expected to be finished before January 1. The remainder of the roads will be built later in connection with the trolley lines, as the company has acquired valuable property in the shape of electric power plants at Coatesville, Downington and Kennett, with options upon others. It is the intention to make extensive additions to these plants.

TEN MILLIONS FOR IMPROVEMENTS—The Edison Electric Company, Los Angeles, Cal., it is announced, has closed a deal as a result of which the sum of $10,000,000 will be expended for the enlargement and general improvement of its system. Three millions of this is to be expended immediately and the other seven millions during a period of five years from the present date. With these funds the Edison Electric Company proposes to increase its total plant capacity to 25,000 horse-power, contemplating the erection of a steam plant at Los Angeles and ground for this structure is now being broken. It is said that the present capacity of the Los Angeles plant is 8,000 horse-power, and there is now being completed a 3,000-horse-power plant at Redlands. With the building and equipping of the new steam plant at Los Angeles, which it is expected will require seven months, the Edison company will have at its disposal 20,000 horse-power by water-power generation and 6,000 horse-power by steam power. It is said that in addition to street railway consumption there is a demand for fully 12,000 electric horse-power along the company's lines and in Santa Anna, Los Angeles and Redlands.

A SPLENDID NEW EXCHANGE IN TOLEDO, OHIO—The Toledo Home Telephone Company commenced operations during this week with about 6,000 subscribers, 2,000 of whom have already been connected. The exchange will be completed by September 15. The company starts on a paying basis and its position is eminently satisfactory. The installation is in every way a model one, and a noticeable feature is the elaborate care which has been taken for the comfort of operators in the furnishing of the sitting rooms, dining rooms and kitchen. The three floors and basement of the building are wholly occupied by the Telephone company. A great many prominent interests in Toledo are represented, 300 stockholders being from that city alone. The building was started in the middle of August, 1901, and the construction makes a record for a large plant. There are two switchboards in the main office. The Sterling Electric Company, of La Fayette, Ind., installed the switchboards for 6,000 capacity, while the East Side exchange was installed by the Stromberg-Carlson Company for a capacity of 5,000 lines. This latter will not be operating for about two weeks. About 400,000 feet of conduit have been used for carrying the underground cables of the company. James Brailey, Jr., of Barber & Brailey, is manager of the Central Telephone Company, and the engineer is Mr. W. C. Polk.

ELECTRIC LIGHTING

DODGE CENTRE, MINN.—This village has just voted to install an electric lighting plant.

RICHMOND, IND.—The city council, by unanimous vote, has accepted the municipal electric light plant built by the Varney Construction Company, of Indianapolis. The plant will be turned over to the commission within a short time.

CHICAGO, ILL.—The United Water and Light Company has acquired the property interests of the Harvey Water and Light Company, the consideration being in the shape of a bond issue of $200,000, and in turn has conveyed the same to the Calumet Gas and Electric Company after executing a trust deed to the American Trust and Savings Bank for the amount of the bond issue, which is made payable July 1, 1907, at five per cent interest.

ONEIDA, N. Y.—The work of erecting the new power plant for the Madison County Gas and Electric Company in Sconondoa street is well under way. Manager Wilhelm has denied that the power to operate the Oneida railway company's new electric lines was to be furnished by his company. The proposition has been considered, but the negotiations have not been concluded. One of the 250-horse-power engines has been set in the new electric light plant.

DANVILLE, PA.—The line of the Standard Electric Company is being extended from the South Danville passenger station to St. Peter's M. E. Church. The work will take about two weeks and a number of lights will be placed in the church. The residents of South Danville and Riverside look upon the extension of the line as an improvement that will result in light being placed in many houses, and that the illumination of the streets by electricity will soon be brought about.

CARTHAGE, TEX.—The Carthage Electric Light and Power Company has its new plant at Belfort completed and nearly all the lights in the village are on the circuit. The plant and equipment have cost something more than $100,000 and developes nearly 2,000 horse-power. As only about 300 horse-power is required to light the village, the company has power to sell. It is likely that several concerns in Carthage, now using either water or steam power, will change to electricity.

BAKER CITY, ORE.—At a special meeting of the city council, a franchise was granted to J. J. Henry and associates to establish and maintain an electric power and lighting plant in this city. The franchise is almost an exact duplicate of the one granted to A. B. Frame, several weeks ago. Mr. Henry proposes to establish a power plant out on Rock Creek, where he will generate electricity by water power and convey the current to this city by means of a line of copper wires. Mr. Henry owns the present electric lighting and power plant in this

city, but he proposes to substitute water for steam power and do away with the steam plant.

BALTIMORE, MD.—It is expected that within two months the wires of the United Electric Light and Power Company will be in the municipal subway system. The cable and other equipment have been ordered, and a force of men will be put to work just as soon as the material arrives. The street lighting service is to be supplied through hollow and ornamental posts. They are to be of wood, with the exception of the goose neck arrangement from which the light is to be suspended.

TULLAHOMA, TENN.—The electric light and waterworks plants are nearly completed, and will soon be running. The dam and power-house, on Elk River, nine miles away, are nearing completion, and everything will be in readiness to turn on the electric current. The project of supplying Winchester and Tullahoma with lights and waterworks is being watched with great interest by parties who supply electrical energy to be used at long distances. In this instance it will require three turbine wheels to run the dynamos that supply the current necessary to accomplish the result expected. The water for Tullahoma will be supplied by two bored wells, 180 feet in depth, being pumped into a large reservoir, and then forced up 120 feet into the water tank, from which the town will be served.

HAMMONDSPORT, N. Y.—The Hammondsport plant, heretofore conducted by P. G. Zimmer, is about to be incorporated with a capital stock of $10,000. The members of the new company are P. G. Zimmer, C. A. Champlin and Judge Monroe Wheeler. Articles of incorporation have been drawn and will be placed on file in Albany. The officers of the new company are: Judge Wheeler, president; C. A. Champlin, secretary and treasurer; P. G. Zimmer, manager. A building of stone, brick and iron, 40 by 52 feet, will be built upon land recently purchased of John W. Davis on Main street, near the inlet, ground for which has already been broken. Another large boiler and a new dynamo will be added, and many other modern improvements made, which will render the plant one of the very latest and best.

BOISE, IDA.—The new electric power plant at South Boise, located one and three-fourth miles from the Boise post office, is now ready to supply light and power. Water taken from the Ridenbaugh canal is the motive power. A fall of twenty feet has been secured by cutting the tail-race several feet deeper. The water is brought into the penstocks, where four newest pattern Leffel turbine wheels have been set, by an immense flume eighteen feet wide, about five feet in depth and 200 feet long. This part of the plant is all completed, and the horizontal turbine water-wheels are installed on a heavy concrete base. The limit of the water-wheels is 500 horsepower, but arrangements have been made to add another wheel whenever it becomes necessary to supply the demand. The cost of the plant complete will be about $30,000. Five miles of pole lines have been put in, and the wiring which is of heavy insulated copper will soon be completed. The officers of the new company are H. O. Pope, president, and M. D. Dobson, secretary and treasurer. Every stockholder is a resident of Boise.

ST. LOUIS, MO.—Clark Brothers, Philadelphia, have purchased the plant of the Citizens' Electric Light and Power Company at East St. Louis, the price being $750,000. The officers of the Citizens' Electric Light and Power Company were James Campbell, of St. Louis, president; Henry D. Sexton, of East St. Louis, secretary, and A. B. Sager, of East St. Louis, superintendent. The Clark Brothers recently purchased the electric lines on the East Side, including the one on the bridge, the one in East St. Louis and the interurban lines which operate to Belleville, Edwardsville and other cities in St. Clair and Madison counties. The company concluded that it could furnish electricity to supply the patrons of the Citizens' Electric Light and Power Company, in addition to that required for the operation of its lines, and for several weeks negotiations have been on between the companies for the purchase of the plant. The officers of the new company will be L. C. Haines, president; H. D. Sexton, secretary, and A. B. Sager, superintendent. Mr. Haines is manager of the company's electric lines.

TELEPHONE AND TELEGRAPH

LYONS, N. Y.—The work of installing the cable system in place of the one now used in the local service of the Wayne County Telephone Company here has been begun.

SYRACUSE, N. Y.—The Central New York Telephone Company is expending $50,000 in rebuilding and enlarging its toll lines. The company has heretofore had lines running west on the Auburn and main lines of the New York Central, south to Cortland and north to Oswego. The new line will run to Watertown.

BUFFALO, N. Y.—Work on the Frontier Telephone Company's system is progressing rapidly, and the foundations of the central exchange are rapidly nearing completion. The company's canvass has been very successful, and by the time it is ready to begin operations it is expected that the list of subscribers will be very large.

FREMONT, NEB.—The city council has granted J. L. Laird, B. W. Reynolds and others a franchise to institute and operate an independent telephone system in this city. The promoters must signify their acceptance within thirty days and commence work within three months. No poles are to be erected in the business part of the town unless a connection can be made in no other way.

TUSCALOOSA, ALA.—The Southern Bell Telephone Company is making arrangements to extend its line from Tuscaloosa to Selma, Eutaw, Greensboro and several points in Mississippi. This will be of great advantage to Tuscaloosa as its present system will be connected with the southern and eastern part of the state. The line has been surveyed and the work is estimated to cost $25,000. The headquarters will be at Tuscaloosa.

CARROLLTON, KY.—Mr. R. M. Barker, president of the Carrollton Telephone Company and of the Independent Long-Distance Telephone Company, is building a line from Owenton, Ky., to Louisville, Ky., connecting the towns of Owenton, Moxley, Carrollton, Port Royal, Newcastle, Lane's Landing, Eminence, Lacie and Shelbyville with Louisville. As soon as the line is completed the balance of Henry, Owen, Trimble and Shelby counties will all be connected with the independent exchange, Louisville.

MONTGOMERY, PA.—The Montgomery Telephone Company is extending its line to North Wales and Lansdale. This is a local telephone line running through Worcester, Towamenein, Skippack and other townships in the central part of Montgomery County. It was started by the Farmers' Union, of Worcester. It is said that nearly every farm in that township is connected by telephone. While it was built for local use only it is likely that the line will be connected with one of the larger systems operating through the county.

BURLINGTON, IOWA—At the recent council meeting an ordinance was adopted, granting the Modern Electric Company, of Burlington, Iowa, its successors and assigns, permission to construct, operate and maintain its lines of telephone and telegraph upon, along, over and under highways of the city of Burlington, in the county of Des Moines, state of Iowa. The contract or ordinance will be submitted to a vote of the people. It is the intention of the Modern Electric Company to connect with a large number of independent mutual companies in Iowa and Illinois, which are not at the present time connected with the city of Burlington. The contracts are ready to be signed up as soon as the franchise is granted.

LYONS, N. Y.—Articles of consolidation of the Lyons Telephone Company and the Wayne Telegraph and Telephone Company into the Wayne County Telephone Company have been filed at the county clerk's office. The new corporation is capitalized at $50,000, to exist for fifty years, and will maintain lines starting from Clyde, running to Rochester, thence to Canandaigua, to Auburn, to Syracuse and back to Clyde; also from Clyde to Red Creek and thence to Rochester, and through all intermediate points, and connecting the various towns, villages and cities of Wayne, Monroe, Ontario, Seneca, Cayuga and Onondaga counties. Directors for first year are: Edward Davis, W. D. Barnard and H. S. Wendell, all of Philadelphia, Pa.; Thomas Robinson, Charles A. Rooker, Dr. Charles H. Towlerton and Charles A. Lux, all but Dr. Towlerton being from Clyde. The consolidation was effected by giving two shares of Wayne County Telephone Company stock of $50 each par value for each $100 share of the Lyons Telephone Company and of the Wayne County Telegraph and Telephone Company.

ELECTRICAL SECURITIES

A greater activity in dealings accompanied the advanced prices of last week's market. Several explanations might be proffered to explain these tendencies, the chief among them evidently being the glowing and magnificent outlook for the country's cereal crops. Then, again, there has been a decided diminution in the uneasiness recently felt with respect to the monetary outlook for the remainder of the summer and autumn. There has been no pronounced improvement in the anthracite coal situation, and it would seem to appear that the troubles in that quarter are not yet near conclusion. The additional labor troubles on the elevated railway lines in New York city, while of local importance, have been treated with indifference and have created scant effect even upon the stock of the railway immediately concerned. A full statement has been made public of the conditions imposed by the administration upon the company applying for the privilege of landing a cable in American Islands in the Pacific. The President has approved of the proposals of the Pacific Commercial Cable Company, and it is expected that such a cable will be in operation within two years. First, it is understood that the concession from the government is in no sense exclusive, no monopoly being granted. Second, the cable must have no station on any but American territory between our Pacific coast and China. Third, maximum rates are specified for commercial business. Besides these stipulations, it is provided that the United States Government shall control the line in time of war or when war is threatened; that contracts with foreign governments shall be void in time of war; that operators and employés, except unskilled laborers, shall be American citizens; that the plant and service shall come up to a specified grade of excellence; and, what might be most important, that a new line independent of any foreign control or combination shall be laid between the Philippines and China.

ELECTRICAL SECURITIES FOR WEEK ENDING AUGUST 9.

New York:	Closing.
Brooklyn R. T.	68¾
Con. Gas	224½
Gen. Elec.	185½
Kings County Elec.	203
Man. El.	134¾
Met. St. Ry.	148¾
N. Y. & N. J. Tel. Co.	175
Westinghouse Mfg. Co.	211
Am. Union Elec. Co.	13¾

A number of transactions has been reported at 13¾ on the outside market for a new electrical security, the American Union Electric Company. This company is a consolidation of a number of smaller electric manufacturing concerns.

The Kings County Electric Light and Power Company has declared a dividend of 1½ per cent, payable September 2.

Boston:	Closing.
Am. Telep. & Tel.	163¾
Edison Elec.	280
Mass. Elec. pf.	97
New England Tel.	145
Western Telephone & Telegraph	102½

Philadelphia:	Closing.
Elec. Co. of America	8½
Elec. Stor. Bat. c	88½
Elec. Stor. Bat. pf.	88½
Philadelphia Elec.	5¾
Union Traction	47¼
United G. I. Co.	109

Chicago:	Closing.
Chicago Edison Light	177
Chicago Telep.	169
Metropolitan El. pf.	92
National Carbon	31¾
National Carbon pf.	103½
Union Traction	15½
Union Traction pf.	51

ELECTRIC RAILWAYS

KALAMAZOO, MICH.—The Michigan Traction Company, it is understood, will expend $70,000 on the lines in Kalamazoo this fall and all of the old cars will be removed from the service. Several extensions will also be made. The new cars are modern and up to date in every respect.

YORK, PA.—The York County Traction Company, will, in all probability, extend its trolley line from Dover to Dillsburg. W. H. Lanius, City Engineer Robert McKinnon, Samuel Harlacker and William Anthony, of Wellsville, have viewed the territory between the two boroughs by way of Emigsville and Wellsville, and were very favorably impressed with it. The proposed line, it is said, will connect at Dillsburg with a line from Mechanicsburg. The latter town is at present connected by trolley with Harrisburg.

ATLANTIC CITY, N. J.—The charter of the Atlantic City and Suburban Traction Company, which is to build a line from Atlantic City to Pleasantville and have a branch line running along the bay shore to connect the suburban towns, has been filed in the office of the county clerk, at May's Landing. The company has a capital of $500,000, and the charter confers the right to build and maintain a trolley line eighteen miles long. The incorporators are E. R. Sponsler, Harrisburg; C. Taylor Leland, Philadelphia, and A. M. Jordan, Atlantic City. Where the terminal will be located in this city has not been made known.

BUFFALO, N. Y.—The Buffalo & Depew Electric Railway is at present trying to secure the right of way through the town of Batavia on its route from Buffalo to this city. The proposed line will pass through Crittenden, Corfu, Batavia, Stafford, Le Roy, Caledonia and Mumford, and the necessary permission for construction has been secured from all the towns with the exception of Batavia. Favorable action is expected in Batavia. The road is already in operation as far as Depew, and the officials say that work on the extension will be pushed rapidly. The road will be eighty-seven miles in length. The Philadelphia Investment Company has financed the road.

INDIANAPOLIS, IND.—The board of public works is looking up street-railway extensions. The Indianapolis company will, by putting a "Y" at Eighteenth street and Montcalm, soon establish a ten-minute service to Cerealinetown. The board tried to have this "Y" moved to Schurmann avenue and Eighteenth street, but the company found it would not fit that intersection. The Martindale-avenue extension is ready if the Atlas engine works will bring its switch tracks to grade, and this is promised shortly. An extension of the Cornell avenue line, or an extension of the College avenue line eastward, is also in the minds of the board to provide service for the rapidly populating district northeast.

MILWAUKEE, WIS.—The Wisconsin Traction, Light and Power Company, which operates an electric railway system in the Fox River Valley and of which John I. Beggs is president, has increased its capital stock from $10,000 to $1,000,000. With its increased capitalization the company, it is said, will have for its object the acquisition, building, maintaining and operating of all kinds of electric power, lighting and traction establishments in any part of Wisconsin. Charles F. Pfister and Postmaster-General Henry C. Payne are said to be the largest stockholders. The original company was incorporated August 4, 1892. The incorporators are Charles F. Pfister, Henry C. Payne, Frank J. Bigelow and John I. Beggs.

DAYTON, OHIO—The Appleyard Syndicate, which is negotiating for the C., L. & N., has purchased valuable terminals in this city and owns the line from Dayton to Lebanon. It is proposed to build a line from this city to join the Dayton & Lebanon, which extends to a point south of the city. By the absorption of the C., L. & N., a complete line will be made possible from this city to Cincinnati. Inasmuch as the Appleyard system controls the Dayton, Springfield & Urbana electric line and also the road extending from Springfield to Columbus the connection between the capital and the Queen City will be made possible. While the company has purchased a large tract of land for terminals here it expects to enter the Union Depot.

PERSONAL MENTION

MR. H. B. THAYER, vice-president of the Western Electric Company, returned last week from Europe, where he had been enjoying a two months' rest.

DR. LOUIS DUNCAN, the eminent electrical engineer, sailed for Paris recently and will remain abroad on engineering work until the latter part of September.

MR. GEORGE A. MCKINLOCK, president of the Central Electric Company, Chicago, spent last week blue-fishing in Great South Bay, the guest of Captain W. L. Candee. The catch is reported to be of phenomenal size and quality.

MR. C. C. WARREN, of the Warren Electric and Manufacturing Company, Sandusky, Ohio, is president of the Inter-Lake Yachting Association during the present season. Mr. Warren is an enthusiastic and accomplished yachtsman. The present flagship is the "Wemco II," a schooner, which Mr. Warren purchased at the opening of the present yachting season in Boston, was the first to cross the finish line in the recent races at Put-in-Bay.

INDUSTRIAL ITEMS

MR. CHARLES F. JOHNSTON, Buffalo, N. Y., has opened new and commodious offices in the Ellicott Square Building. Mr. Johnston deals in railway equipment and electrical machinery.

MR. CHARLES S. MALTBY announces that Mr. J. P. Hornaday, who has heretofore been associated with him in the Maltby-Hornaday Company, is no longer associated with him in any way.

THE GEORGE WORTHINGTON COMPANY, 95 to 103 St. Clair street, Cleveland, Ohio, has issued a comprehensive catalogue of electrical supplies. An excellent feature of this catalogue is the indexing systems which enable one to turn to any desired product by reference to the index without searching the entire catalogue.

MR. C. H. RACE has purchased the Signaloid Chemical Works, of Jersey City, devoted to the manufacture of "Signaloid," a coloring and frosting compound for incandescent lamps and other decorative glass work. Mr. Herman Greeder, chemist and founder of the Signaloid company, is traveling in the West this week in the company's interest.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY reports the sales of Westinghouse integrating wattmeters for the month of June to have been the largest in the history of the company. Also, the sales of Westinghouse transformers have more than doubled in the past six months, and the transformer building capacity of the Westinghouse company has been largely increased to meet the demand for "O D" and type "N" transformers.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY states that since offering its souvenir paper-weight a few weeks ago, this little article is in great demand. Already a great number of them have been sent on requests from customers. The company has had a large number of requests from others on the proposal to send this article for ten cents to cover postage and packing. The company reports a steady increasing demand for its popular line of fuse wire and links and telephone supplies.

"THE FOUR TRACK NEWS" for August contains a delightful article on "Doctor Brooks and His Family of Comets." The article is entitled "A Journey Among the Stars," and is from the pen of one of New York's gifted sons, Mr. Frank W. Mack, for years eastern manager of the Associated Press. This story is full of dramatic interest and is well illustrated. Mr. Mack is one of the charter members of the Saratoga Limited Club and is very popular among both the railroad and press representatives of the country.

THE BABCOCK & WILCOX COMPANY, New York city, manufacturers of water-tube steam boilers, have been the recipients of a warm recommendation due to the report of the committee appointed by the Lords Commissioners of the British Admiralty, to consider certain questions respecting modern types of boilers for naval purposes. It appears that water-tube boilers are being very little used on large ships belonging to the mercantile marine. The only type of water-tube boiler inspected was the Babcock & Wilcox, and in each instance the report has been highly commendatory and concludes specifically upon the merits of the Babcock & Wilcox water-tube boilers for marine operation.

THE OTIS ELEVATOR COMPANY reports orders received for fifty-one electric elevators and fifteen hydraulic elevator equipments during the past week. The company has received an order from the Manhattan Railway Company for four heavy electric passenger elevators equipped with magnet controlling devices, to be installed in the new station at 110th street near Eighth avenue, New York. Each of these elevators will have a maximum lifting capacity of 3,300 pounds, and a speed of 300 feet per minute. The travel of each car will be sixty feet. Seven complete electric elevators have been ordered by the General Electric Company for the Schenectady shops of the company.

THE AMERICAN PATENTS PUBLISHING COMPANY, Washington, D. C., has issued a prospectus of the business based upon the importance and value of the digests and monthly publications compiled by James T. Allen, examiner of the United States Patent Office. This sets forth the object and aim of the company, which is to collect information from the records of the United States Patent Office, compile it in comprehensive form, and disseminate it broadcast throughout the world. This is to be accomplished by the publication of a number of digests of patents of certain arts, from the beginning of the granting of letters patent by the United States Patent Office up to a late date, and then perpetuate these publications in periodicals issued monthly.

THE WRENN COMBUSTION GOVERNOR COMPANY, New York city, manufacturer of combustion governors and steam damper regulators, has been incorporated under the laws of the state of New York. The capital stock of $150,000 is divided into 1,500 shares of $100 each. The president is Mr. B. W. Wrenn, passenger traffic manager of the Plant System, Savannah, Ga.; the vice-president and general manager is Mr. H. B. P. Wrenn, electrical engineer, 229 Broadway, New York; the second vice-president is Mr. William P. Clotworthy, Baltimore, Md., and the secretary and treasurer is Mr. James Day Farnsworth, of New York city. The company starts under auspicious circumstances, as the directorate is composed of men well known to the field which it will endeavor to supply. The number of boilers in use throughout the world offers a practically unlimited and constantly increasing field for the company's manufacture, and it is claimed that the reports of experts, which will be mailed to any interested upon application, give promise that the product of this company will become very popular.

THE A. G. SCHOONMAKER COMPANY, 126 Liberty street, New York city, is the representative of the Eager Electric Company, of Watertown, N. Y., builder of direct-current apparatus. Among the recent installations of the Eager apparatus may be mentioned: J. H. Lebkuecher, Newark, N. J., six 150-kilowatt direct-connected generators; the Analomink Paper Company, Water Gap, Pa., one 30-kilowatt direct-connected generator; the Black River Traction Company, Watertown, N. Y., three 200-horse-power engine-type, direct-connected railway generators and one 50-kilowatt booster set. The Schoonmaker company carries in stock the Ward-Leonard automatic starting boxes of all sizes, and a full line of small motors. It ships rebuilt cars from its shops in Brooklyn, and among those recently shipped were a large vestibuled car for the East Moline & Watertown Street Railway Company, and seven open cars for the East Bangor, Portland & Delaware River Street Railway Company. Several 150-ton hydraulic wheel presses have also been shipped during the past month. The company reports a very satisfactory state of trade at the present time.

THE AMERICAN UNION ELECTRIC COMPANY—Mr. S. Marsh Young, of the American Union Electric Company, announces that that company, in addition to its purchase of the Union Railway Power and Electric Company, Morris Electric Company, the Falson Electric Manufacturing Company, Electric Motor Specialty Company, Fountain Manufacturing Company, the Federal Manufacturing and Specialty Company and Refrigerator Machine Company, has added to its line of purchases the Metropolitan Switchboard Company. All the capital stock of the Metropolitan Switchboard Company was purchased from Messrs. Charles L. Eidlitz, T. J. Murphy and G. A. Annable. The American company intends to continue to operate the factory of the Metropolitan Switchboard Company at West Twenty-ninth street, as an auxiliary to its plant at Ampere, N. J., and in the Twenty-ninth street factory will handle all switchboard and special panel-board work under the supervision of Mr. T. J. Murphy, president of the Metropolitan Switchboard Company. The purchase of the Metropolitan Switchboard Company by the American Union Electric Company carries with it the ownership of the "Murphy" patents, which relate to all forms of installation of panel-boards, as well as built-up panel-board boxes and the divisible panel-board. There has been considerable controversy between the Metropolitan Switchboard Company and the several manufacturers of panel-boards, but the American Union Company announces that it will probably turn in these patents to the general benefit of the panel-board business, and will issue licenses to about a dozen of the principal panel-board manufacturers, its object being to strengthen the general situation and to enable the legitimate panel-board manufacturers to receive a fair return on their investment. The new additions to the factory of the American Union Electric Company at Ampere, N. J., covering about 23,000 square feet of floor space, are about completed, although plans are being prepared for the still further addition of a new brick building 300 by 50 feet for a general machine shop, as well as office building and warehouse.